Impact of Militarization of Artificial Intelligence (AI) on Strategic Stability in South Asia: A Case of India-Pakistan Strategic Environment

By

Muhammad Zaryab
(00000363437)

Supervisor:

Dr Imdad Ullah

Department of Peace and Conflict Studies (PCS)

Centre for International Peace and Stability (CIPS)

National University of Sciences & Technology (NUST)
Islamabad, Pakistan

(2023)

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Muhammad Zaryab

(Registration No: 00000363437)

A thesis submitted to the National University of Sciences and Technology, Islamabad, in partial fulfilment of the requirements for the degree of

Masters of Science

in Peace and Conflict Studies

Thesis Supervisor:

Dr Imdad Ullah

Department of Peace and Conflict Studies (PCS)

Centre for International Peace and Stability (CIPS)

National University of Sciences and Technology (NUST)

Islamabad, Pakistan

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Signature: _____

Name of Supervisor: Dr Imdad Ullah

Date: 18-08-2023

Signature (HOD): _____

Date: 18-08-2023

DR MUHAMMAD MATEEN

Signature (Dean/ Principal) _____

Associate Dean
Centre for International Peace and Stability
NUST Institute of Peace and Conflict Studies
Islamabad

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Examination Committee Members

1. Name: Dr Muhammad Makki Signature: _____

2. Name: Dr Bakare Najimdeen Signature: _____

3. Name: _____ Signature: _____

Supervisor's name: Dr Imdad Ullah Signature: _____

Date: 18-08-2023

_____
Head of Department

18-08-2023
Date

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Dean/Principal

Associate Dean
Centre for International Peace and Stability
NUST Institute of Peace and Conflict Studies
Islamabad

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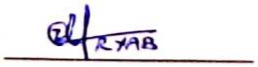
Student / Author Signature: 

Name: Muhammad Zaryab

(Registration No: 00000363437)

For the greater cause of peace and stability in
South Asia

ACKNOWLEDGEMENT

I am very grateful to Allah Almighty for always guiding me towards the right path. I would like to express my gratitude to my supervisor Dr Imdad Ullah for his cooperation, guidance and necessary support during the whole journey. I am thankful to graduation examination committee members, Dr Muhammad Makki and Dr Bakare Najimdeen Ayola for their exceptional support and guidance for this project.

I am thankful to Dr Tughral Yameen (former Assoc. Dean CIPS) for his inputs necessary for the completion of this project. I am grateful to all faculty members at CIPS for their guidance, help in making me understand various dimensions and complexities of peace and conflict studies.

I am extremely grateful to my parents for their help, guidance, support and love that they showered upon me throughout my life and their necessary guidance and support during my whole academic journey, especially my mother, whose penchant for education always encourages me to learn more.

I am also thankful to Mr. Ibrahim (librarian at CIPS) for his timely support in finding relevant reading material. I am grateful to all faculty members and staff at CIPS for making the environment at CIPS conducive to learning and for making CIPS a great seat of learning.

Abstract

AI has impacted all domains of life. Applications of AI in military domain is no exception. In the military domain, AI has applications in the field of logistics, surveillance, navigation, intelligence gathering, decision making, communication systems, cyber security, information security etc. It also find applications in the domain of robotics and autonomous systems. AI also helps in decision making. On the other hand, such systems are also vulnerable. AI based systems have huge security related issues. For proper functioning, safety of AI based systems is of huge importance. Moreover, there are many ethical issues associated with autonomous systems. Such systems must comply with international guidelines and humans must remain in decision making. Next, due to conventional asymmetry between India and Pakistan, militarization of AI is able to impact strategic stability in South Asia. The aim of this research work is to explore, the impact of integration of AI in weapon systems by India on strategic stability in South Asia, because India has conducted numerous violations of Pakistan's maritime boundary and is also involved in manipulating cyber space. Therefore, it is important to highlight the impact of militarization of AI by India on strategic stability in South Asia. On the other hand, the importance of infrastructural developments, indigenous research and development etc., for Pakistan is also highlighted. In this research work, qualitative research approach is employed. This research is exploratory. Semi-structured, in-depth interviews are conducted to gather information and data relevant to the subject under consideration, from experts in the field of nuclear deterrence, strategic stability, AI, ML etc. Also, research journals, books, documents from online sources, expert opinions are explored as secondary sources to substantiate argument.

Table of Contents

Abbreviations & Acronyms

AI Artificial Intelligence

ML Machine Learning

ANN Artificial Neural Networks

ASI Artificial Super Intelligence

GPU Graphics Processing Unit

GAN Generative Adversarial Network

UAV Unmanned Aerial Vehicle

UUV Unmanned Underwater Vehicle

USV Unmanned Surface Vehicle

IC Integrated Circuit

RMA Revolution in Military Affairs

C4ISR Command Control Communication Computer Intelligence Surveillance Reconnaissance

CAIR Centre for Artificial Intelligence and Robotics

C3I Command Control Communication Intelligence

DRDO Defence Research and Development Organization

NDAA National Defence Authorisation Act

DAIC Defence Artificial Intelligence Council

SSBN Nuclear Powered Ballistic Missile Submarine

DAIPA Defence Artificial Intelligence Project Agency

US United States

USSR United Soviet Socialist Republic

UN	United Nations
IT	Information Technology
LOC	Line of Control
UK	United Kingdom
LAWS	Lethal Autonomous Weapon System
GGE	Group of Governmental Experts
CCW	Certain Conventional Weapons
NATO	North Atlantic Treaty Organization
EU	European Union
PLA	People's Liberation Army
ISRO	Indian Space Research Organization
UNHCR	United Nations Human Rights Council
NGOs	Non-Governmental Organizations
5G	5^{th} Generation
NSS	National Security Strategy
MIT	Massachusetts Institute of Technology
DOD	Department of Defence
IoT	Internet of Things
RMB	Renminbi
NCW	Network Centric War

Introduction

Background

AI is an interdisciplinary field having roots in linguistics, mathematics, psychology, statistics, neuroscience, control theory etc. (Tecuci , 2012). AI is relatively a new field of knowledge that helps to solve complex problems and to make the machines learn intelligence (Tyugu, 2011). Research in AI was initiated in 1940s (Sayler, 2020). AI was first used by John McCarthy in 1956 (ai.nl, 2021). However, AI has made huge progress during the past few years (Kitsios, Kamariotou , Syngelakis , & Talias , 2023), which is due to the advancements in ML, innovations regarding computer processing and big data sources which proliferated in the past two decades (Sayler, 2020).

Machine Learning (ML) is a subset of AI (Kavlakoglu, 2020). ML based systems *"progressively improve performance through recognizing patterns among large data sets, and such systems take corrective measures without being explicitly programmed"* (Morgan, et al., 2020). ML is regarded as the probabilistic approach to AI, involving algorithms which learn to predict by analysing data (Surber, 2018). ML algorithms have applications regarding data-driven decision making (Galán, Carrasco, & LaTorre, 2022). Further, deep learning is a subset of ML (Kavlakoglu, 2020). Deep learning algorithms tries to copy the layer of neurons that are present in human brain (Surber, 2018). Deep learning solves problems that are beyond the sphere of influence of traditional ML approaches, traditional ML approaches depends upon human intervention regarding the identification of features required for training of ML model, deep learning models self-learn such features (Jarrahi, Kenyon, Brown, Donahue, & Wicher, 2022).

Next, Big data can be defined as, *"a collection of large data sets that contain massive and complex data"* (Lucarelli, MARRONE, & MORO, 2021). AI and big data help in decision making at strategic, tactical and operational level and also helps military capabilities in all landscapes; human, physical and information (Smallegange, Venema, Bastiaansen, & Bronkhorst, 2018). For combat readiness, synergy between AI, ML and big data is necessary (Lucarelli, MARRONE, & MORO, 2021). Also, computational intelligence plays an important role in big data, agents analyse historical and real-time data using computational techniques and find out the correlation between them and patterns (Kibria, et al., 2018). Moreover, *"Intelligent*

agent" first emerged as a concept in 1990s, they analyse the environment and take action accordingly to maximize benefits (Artificial Intelligence and Robotics, 2017).

Leyer et. al, has maintained that the basic difference between AI and traditional software lies in the analysis of big data, i.e., to learn from big data and to draw conclusions, the processing of big data in AI based systems, need not to be programmed rather AI system processes the data from ML process with the passage of time (Leyer, Oberländer, Dootson, & Kowalkiewicz, 2020).

Literature Review

Wilner & Babb, has written that, AI will increase the certainty and severity of punishment in case of conflicts, by compressing the time between intelligence, decision and action, because users will have access to real time intelligence from different sources. It also enhances the pace of action in other related domains of national security like; cybersecurity, counter espionage, counterterrorism etc. (Wilner & Babb, 2021).

Rickli et. Al, has written that, there are issues regarding the justification of outcomes of AI based systems. It is known as *"black-box"* problem in AI. Due to complex mathematical operations and probabilistic operations, it is very difficult to assure the accountability of ML process. This problem restricts the adoption of such technologies due to the lack of trust associated with their outcomes (Rickli & Ienca, 2021).

James Johnson, has written in his article about the factors due to which AI is evolving. It includes; expanded datasets, growth of computing power, expansion in investments related to AI, increase in commercial interest and advancements regarding the implementation of machine learning algorithms, especially deep neural network (Johnson J. , The AI-cyber nexus: implications for military escalation, deterrence and strategic stability, 2019).

Nobumasa Akiyama, has written that, integration of latest technologies like; robotics along with AI and hypersonic glide in weapons have blurred the distinction between conventional and non-conventional weapons and also blurred the boundaries between strategic and non-strategic weapons and increased the strategic significance of non-nuclear weapons (Akiyama, 2021).

Christopher F. Chyba, has explained in his article, that strategic stability includes "*crisis stability"* and *"arms race stability"*. Crisis stability tells that even in case of crisis, states refrain from resorting to nuclear weapons first due to the threat of retaliation, and arms race stability exists when a state has incentives to avoid action reaction cycle which results in undermining first strike capability (Chyba, 2020).

James Johnson, has written in his article, that capabilities enhanced by AI will have huge impact on strategic stability. Militaries which will use AI will have many advantages; compression of decision-making loop, battlefield manoeuvring etc. Also, the impact of AI on deterrence and strategic stability will be determined by the perception of one's adversaries. Due to misperception, it will increase the risk of inadvertent escalation. Risks regarding escalation are significant in future warfare in case of USA and China (Johnson J. , Artificial intelligence & future warfare: implications for international security, 2019).

Eric Schmidt, has written in his article, that AI is increasing misinformation and cyber threats. Due to AI, conflict between conventional armed forces is harder to control because of the rapid actions and decision making. Also, AI based intelligence and military capabilities may disturb strategic stability by disrupting the premises of nuclear deterrence (Schmidt, 2022).

James M. Acton, has explained cyber interference in his article. Cyber interference with C3I systems etc., involve two operations, which are attack and espionage. In cyber espionage, data is collected from target system without damaging such system, e.g., sensitive information exfiltration by cyber tools. While, in cyber-attack, operations of systems which are attacked are undermined by compromising their integrity etc. (Acton, Cyber Warfare & Inadvertent Escalation, 2020).

It is maintained in a report by US Institute of Peace, that in context of South Asia, continuous evolution of technology is making the whole region dangerous and advancements in AI, cyber domain, autonomous systems, delivery systems etc., will create challenges for military planners in China, Pakistan and India, in the next 5-10 years (Enhancing Strategic Stability in Southern Asia, 2022).

Tuomi has written in a report by European Commission, that the most important restriction to AI is the availability of data. With limited datasets it is very difficult to give rise to efficient AI based systems (Tuomi, 2018). Kim has written that, systems trained on specific data sets will be vulnerable to adversarial attacks, and with limited data, artificial neural networks (ANN) will only make poor generalizations (Kim, 2021).

Leyer et. al has maintained that, AI systems with more information might outperform systems with incomplete and inaccurate data (Leyer, Oberländer, Dootson, & Kowalkiewicz, 2020). A 2017 report maintains that 90 per cent of world's data is generated within the preceding 5 years and developers of *"graphics processing unit (GPUs)"* which is a hardware necessary for AI are also increased (FRANKE, 2021).

Vincent has argued that in 1965 Gordon Moore has proposed that after every one and half year, the surface area associated with transistors will reduce by 50 per cent, due to which total number of transistors on IC will get doubled and the speed will also get doubled, known as Moore's Law (Joolen, 2000). Kim has maintained that, with the advancements in big data analysis, computational power and ML, AI became involved in the development of weapons around 2010 which continued till date (Kim, 2021).

Fabio Rugge has maintained that considering the political priority and the gravity of investments regarding the development of disruptive technologies, it is clear that an arms race is ongoing between US, China and Russia (Villasenor, 2019). Araya & King, has written that as far as research in AI is concerned, US is leading globally, in research on AI, US National Science Foundation invests more than $100 million annually, DARPA has also announced an investment of $2 billion annually in *"AI Next"* an initiative regarding AI (Araya & King, 2022). China has also launched various multibillion-dollar AI initiatives, European Commission has also launched plan regarding AI for 2020s with *"more than €20 billion per year from public and private investments"* (Villasenor, 2019).

It is written in US NSS 2022, that modern technologies have transformative impact on warfare, US and her allies are investing in modern technologies as well as their applications in; space domain, AI, cyber domain, quantum systems etc., US will also strive to overcome issues in joint capability development (NATIONAL SECURITY STRATEGY, 2022).

There are many issues associated with autonomous systems. It is written in a report by ITU, there is a need to raise awareness regarding the disruptive power associated with modern technologies and their negative impacts must be prevented (United Nations Activities on Artificial Intelligence (AI), 2018).

Research Objectives

AI has huge impact on all domains. In the military domain applications of AI are in surveillance, logistics, transportation, intelligence etc. AI also find applications in the cyber domain. India is beefing up its strategic assets, integration of AI will create challenges for the regional security. India is striving to exert her hegemony in the region. India has conducted violations of Pakistan's maritime boundary many times. Indian intentions will create challenges for South Asian stability. This work will explore the applications of AI in military platforms, vulnerabilities associated with AI based systems. The objective of this research work is to explore the applications of AI in military domain, and the impact of militarization of AI by India on strategic stability in South Asia. Moreover, it will also highlight the likely timeframe in which AI based systems will become mature enough to tilt strategic balance in South Asia.

Research Questions

- To what extent AI based systems will be able to replace conventional military systems that were inducted before the inception of AI based systems?
- How integration of AI by India in military platforms is concerning as far as strategic stability in South Asia is concerned?
- What is the likely timeframe in which AI driven weapon platforms are able to tilt strategic balance in favour of either India or Pakistan?

Research Methodology

In this research work, qualitative research method is used to explore various dimensions of militarization of AI and the impact of integration of AI in military platforms on strategic stability

in South Asia. This research is exploratory. In order to conduct interviews research questions are designed. Research questions are designed in accordance with the research objectives i.e., all the questions are designed to govern different aspects regarding the subject matter and to fulfil all the research objectives.

For the collection of data necessary for this research work, sample size is selected. It is selected according to research questions, research objectives and expertise of the respondents. Multiple experts are accessed in order to get their views in order to gather data and information relevant to the subject under consideration. Response from these experts is enough to analyse various dimensions of militarization of AI, cyber-space etc., and their impact on strategic stability in South Asia.

Moreover, in this research work, case study approach is employed to analyse data specifically (Zainal, 2007), and to explore the dynamics and complexities of a single case (Patnaik & Pandey, 2019), because major aim of this research work is to explore the impact of integration of AI in military platforms on strategic stability in South Asia. Subject under consideration is specified and restricted between Pakistan and India. Doing this helps to explore the impact of militarization of AI in detail and to govern in-depth impact on multiple dimensions of military domain which have significant impact on strategic stability in South Asia and the possible actions to balance the strategic environment between Pakistan and India.

In order to collect data for analysis primary and secondary tools are utilized, the primary tools which are employed to collect data and information necessary to analyse various dimensions of AI and its applications in the military domain and its impact on strategic stability is interviews, which are conducted from experts in the field of nuclear deterrence and strategic stability, AI, ML, big data, neural networks, robotics, autonomous systems, communication systems and information systems, cyber-security and electronic systems.

In this work, semi-structured, in-depth interviews are conducted in order to get answers to the research questions. To gather relevant data, interviews are conducted as one to one. These one-one interviews are very helpful in unravelling the respondent's experience (Ryan, Coughlan, & Cronin, 2009). An amalgam of open ended and close ended questions is used (Adams, 2010). Questions are also moulded according to the expertise of the various respondents, because some

respondents have expertise in the domain of nuclear deterrence in South Asia and impact of technological advancements on strategic stability between Pakistan and India, and some respondents have expertise in the domain of AI, ML, big data, neural networks etc., while, some respondents have expertise in the domain of communication and information systems, applications of AI in the cyber domain and security of cyber-space and impact of AI on the performance of electronic systems. These interviews also provide an opportunity to explore spontaneous issues put forward by the respondents (Ryan, Coughlan, & Cronin, 2009).

Firstly, impact of integration of AI in various domains of military is enquired from the respondents. In the military domain AI has implications in almost all domains. Secondly, various issues arising in the operationalization of AI based systems are enquired. These issues include vulnerabilities associated with the AI based systems like; security issues, hacking, malfunctioning, software failure etc., Next, impact of integration of AI in various military platforms by India is enquired from the respondents. The consequences of advancements in the domain of AI, cyber-space and space by India is governed, and the consequences of militarization of modern technologies on the nuclear deterrence in South Asia. Later on, the likely timeframe is enquired regarding the AI based systems to become mature enough to impact strategic stability in case of India and Pakistan. Follow up questions are also asked based on the various dimensions regarding the subject matter appearing during the interviews.

In this research work, the secondary sources which are analysed to govern the advancements in the military domain as a result of AI and the impact of integration of these technological tools on strategic stability between Pakistan and India, are books, journal articles, periodicals, reports, expert opinions and documents from various online sources. There are many advantages of these secondary sources. They provide with an opportunity to access material regarding nuclear deterrence in South Asia, AI, ML, cyber-systems, militarization of space and various other frontier technologies without the limitations of time and place.

In order to record answers to the research questions from respondents, written notes are taken, because in order to gather views of respondents and to preserve their responses, recording of data is necessary. Respondents ate informed in advance that their views are recorded in written form for the purpose of this study. There are many advantages of notes writing, data taken from

interviews is readily accessible (Muswazi & Nhamo, 2013), and participants remain aware of necessary pauses in the conversation (Bolderston, 2012).

From the views of respondent's major themes are extracted. Findings from each interview is compared with those which have previously emerged in order to confirm *"saturated terrain"* (Vasileiou, Barnett, Thorpe, & Young , 2018). Saturation is confirmed when further collection of information or data is not necessary (Saunders, et al., 2018). After saturation, no more interviews are conducted.

In order to conduct content analysis, themes are also gathered from the review of literature regarding the impact of militarization of AI on strategic stability in South Asia. These themes are used to explain integrating ideas (Bazeley, 2009). Themes are compared in order to thoroughly analyse; the impact of technological advancements on the performance of various military platforms, to explore numerous security related issues, various vulnerabilities that are creating challenges for the proper functioning of AI based systems, and impact of advancements in the domain of AI by India on strategic stability in South Asia.

Themes from the Analysis of Literature (Enhancing Strategic Stability in Southern Asia, 2022), (Rafiq, 2020), (Khan S. M. & Alexander , 2020), (Gandhi, 2010)**:**

1.	Technological advancements as a result of AI are able to impact strategic balance in future.
2.	Integration of AI by India is creating challenges for strategic stability in South Asia.
3.	Militarization of AI by India has instigated an arms race.
4.	Strategic significance of silicon chips.
5.	Indigenization of Science and Technology.

Problem Statement

In case of South Asia, impact of integration of AI in military platforms on strategic stability between Pakistan and India needs analysis. There is an exigent need to explore the factors that are directly and indirectly impacted by the militarization of AI in South Asia. India is integrating AI in military platforms at an increasing rate. Pakistan is also advancing in the domain of AI. Indian endeavours are creating disturbance in the region, because India is involved in waging 5G war and hybrid war against Pakistan. India is also involved in misinformation campaign against Pakistan. Induction of AI based systems etc., by India are concerning for strategic stability in South Asia. The consequences of militarization of such technologies by India on the regional security dynamics need to be explored.

Research Significance

AI has impact on all domains of life. Countries are integrating AI in their systems at an increasing rate. Whether the systems are drones, airplanes, submarines, ships or tanks AI has huge significance as far as the performance of such systems is concerned. States will need highly trained manpower in coming years. Moreover, with the inception of 5^{th} generation warfare states are in urgent need of systems that are efficient enough to counter cyberattacks. It will be possible only with the integration of AI. Moreover, AI also has significant importance regarding decision making. There are also issues associated with the manipulation of AI for negative purposes and technical limitations. Such issues have given rise to strategic imbalance. Next, increased integration of AI by India in military systems is concerning for strategic stability in South Asia. Therefore, there is a need to explore the impact of militarization of AI on strategic stability in South Asia. It is also important how Pakistan will act to leverage the benefits of AI which will further balance and stability in the region.

Research Plan

1^{st} chapter is dedicated for conceptual framework. Militarization of AI and strategic stability is the framework through which impact of AI in bringing technological advancements and impact

of integration of AI in military platforms on strategic stability in South Asia is explored. In the 2nd chapter, impact of integration of AI in military domain is discussed in detail. AI has impact on the performance of the systems in which it is integrated. In this chapter different applications of AI in military systems are explored. In the 3rd chapter, militarization of AI and strategic stability is discussed from the global perspective. Countries are striving in this domain and are investing in various projects regarding AI to get various advantages.

In the 4th chapter, impact of militarization of AI on strategic stability in South Asia is discussed. India is integrating AI in military domain at an increasing rate. India is involved in waging hybrid war against Pakistan. India is involved in misinformation and disinformation campaign against Pakistan. Also, India is militarizing cyber space and space. Indian endeavours are concerning for strategic stability in South Asia. This chapter discusses impact of such activities on strategic stability in South Asia and the measures necessary to counter instability and to foster peace and stability in the region.

Chapter no 1

Conceptual Framework

Militarization of AI and Strategic Stability, is the framework through which the impact of militarization of AI on strategic stability in South Asia is governed (Johnson J. J., 2020). Because advancements regarding the integration AI etc., in military platforms by India are concerning for strategic stability in South Asia (personal communication, September 29, 2022).

1.1 AI

AI is regarded as *"the science of making machines do things that would require intelligence if done by men"* (Geist & Lohn, 2018). US National Defence Authorisation Act (NDAA) 2019 defined AI as: *"a system developed in computer software, physical hardware, or other context that solves tasks requiring human-like perception, cognition, planning, learning, communication, or physical action"* (Khan M. , 2019). Advancements in the domain of AI resembles reasoning abilities of human brain (Araya & King, 2022). AI is not a stand-alone technology; it supports existing functional applications (Szabadfoldi, 2021). Impact of AI will depend upon the type of technology in which it is integrated (Abid, 2021). Integration of AI in industrial sector is regarded as the 4th industrial revolution (Janani, 2021).

1.1.1 Uses of AI

AI has impact on how we work, learn and live (Sarirete, Balfagih, Brahimi, Lytras, & Visvizi , 2021). It has practical utilization in diverse i.e., home utilities, cars, banks, hospitals, in space exploration, manufacturing sector and in search engines, and find applications in many domains like; robotics, game theory, language processing and computer vision etc. (Liu, et al., 2018). AI is also widely used in medicines, industry, semiconductors and space technology etc. (Janani, 2021). 2017 UN AI summit, pinpointed that AI has the potential to further advancements for dignified life ('Advances in AI could solve major environmental crises', 2019).

Rapid advancements in AI have transformed the way businesses work (Artificial Intelligence (AI) Strategy, 2021). In the banking sector, AI based systems are able to overcome issues like malpractices (Nadimpalli, 2017). AI is useful in remote learning, remote medical consultations (Ilyas, 2021). It also find applications in environmental sector, AI and ML helps in

environmental inspections by analysing images taken from drones and satellites, it also helps in increasing regulatory effectiveness, helps in clean energy and energy management etc. ('Advances in AI could solve major environmental crises', 2019). AI based systems are widely used in shipping industry in logistics and to identify issues arising in supply chains (Nadimpalli, 2017). AI will help decision makers with alternative options in various situations based on the huge amount of information (Wilner & Babb, 2021).

There are four kinds of AI based systems: systems that act like humans, systems that think like humans, systems that think rationally and systems that act rationally (Sayler, 2020). Inputs that are required for AI are; data, ability to develop algorithms and computing power necessary to execute algorithms (FRANKE, 2021). AI based systems became better with the analysis of more and more data (Gatopoulos, 2021). Also, the reliability of AI systems commensurate with the data sets with which such systems are trained (Vynck, 2021).

1.1.2 Types of AI

AI is divided into three types; artificial narrow intelligence, artificial general intelligence and artificial super intelligence (Rickli J.-M. , 2018). Artificial narrow intelligence can perform one task at a time (Burton & Soare, 2019), like speech recognition etc. (Levy, 2020). In artificial general intelligence, virtual agents strive for intelligent behaviour in virtual reality (Brunette, Flemmer, & Flemmer, 2009). Strong or general AI have applications which depicts cognitive abilities like humans (Levy, 2020). Artificial super intelligence (ASI) refers to those systems which have surpassed humans in intelligence (Pohl, 2015). Systems based on ASI will outperform humans in areas such as wisdom, logic and scientific creativity (Szabadfoldi, 2021). Advancements in technology at an exponential rate will results in *"singularity"* intelligence which is even smarter than humans (Tyugu, 2011). Learning methods for AI based software are; supervised learning, unsupervised learning and reinforcement learning, in supervised learning, labelled data e.g., images are given to the software, new data is categorized by the software based on categories of data given as input, but in unsupervised learning the data given as input e.g., images are not labelled and AI based software tells about the categories (Barlaas, 2021).

1.1.3 Applications of AI in Robots

Integration of AI in robots has gain importance. Such robots can perform various tasks. Robots sent to planets and satellites are all embedded with AI (Boden, 2018). Robotic systems based on AI are deployed for air-air refuelling of aircrafts (Gatopoulos, 2021). AI also helps in face-recognition, attitude-recognition and fingerprint-recognition (Sumak, Brdnik, & Maja, 2021). M. L. Cumming, has maintained that research & development regarding autonomous systems is happening globally and countries are striving for various autonomous systems like autonomous underwater and autonomous ground vehicles (Cummings, 2017). AI based systems are viable for dangerous environment (personal communication, September 11, 2022). Irrespective of humans, robots will be used in dangerous environment (personal communication, September 29, 2022). For example, Zoe is a robot which perform analysis on samples and postulates whether further exploration is needed or not, and Groundhog is a robot which passes over underground mines in order to reduce the dangers associated with humans (Brunette, Flemmer, & Flemmer, 2009). MIT has experimented robot doctor for treating patients of covid-19 (Ilyas, 2021).

1.2 Militarization of AI

AI has revolutionized military domain. In the military domain, AI find applications in command and control, logistics, autonomous vehicles etc., (Sayler, 2020), and in *"non-kinetic"* domain like intelligence, surveillance etc. (Garcia E. V., 2021). AI results in enhancement in the country's capacities in military planning, communications, logistics, recruitment, training etc. (Wilner & Babb, 2021). AI also helps in predictive maintenance etc. (Araya & King, 2022). ML algorithms are trained e.g., with data related to aircraft maintenance to anticipate faults before they lead to serious issues (Chahal, 2021). At the operational level, AI find applications regarding big data, autonomy, robotics, tracking of troops movement (Johnson J. J., 2020), maintenance, planning, logistics and war gaming (Johnson J. , The Impact of Artificial Intelligence on Strategic Stability, Escalation and Nuclear Security, 2019). AI based pilots score high as compared to their human counterparts in war gaming (Gatopoulos, 2021). A major issue in the use of ML for military operations is the lack of actual combat data, algorithms are trained based on data from simulations (Altmann, 2020). In unmanned systems, AI results in improvements in autonomous control (Svenmarck, Luotsinen, Nilsson, & Schubert, 2018). On the other hand, at the strategic

level, applications of AI are in surveillance, intelligence, target recognition and cyber domain etc. (Johnson J. J., 2020).

Hanlon has maintained that innovation in the military domain is evolutionary rather than revolutionary, robots, remotely piloted aerial vehicles and small satellites have been operationalized in military but have not displaced systems that were operationalized before the induction of such modern military systems (O'Hanlon, 2018). Current revolutions in military affairs are regarding the storage abilities and computational power associated with computers, and with the advancements in technology like fiber optics communication and technologies related with encryption etc., data processing power of systems will get enhanced (Neuneck & Alwardt , 2008). However, ML and AI will be used for automation of image recognition by satellites and analysis of data obtained from satellites and radars, and ML will not be used in strategic command and control and delivery systems (Boulanin, Saalman, Topychkanov, Su, & Carlsson, 2020).

AI has impact on warfare and military tactics (AI brings paradigm shift in modern warfare & state security, moot told, 2022). Pentagon has released a report on AI which maintains that it will enhance the ability to predict, analyse and respond to physical and cyber attacks (Johnson J. , The Impact of Artificial Intelligence on Strategic Stability, Escalation and Nuclear Security, 2019). US *"National Defence Strategy"* of 2018 maintains that character of war will be changed with AI (Sayler, 2020). By 2050, battlefield will depend upon cyber capabilities, information space and human force trained with modern skills, and AI will change the balance of power between rivals and will augment offensive capabilities over defensive and ameliorate *"deterrence by punishment"* as compared to *"deterrence by denial"* (Wilner & Babb, 2021). European Defence Agency has pointed out 10 major disruptive innovations in defence which includes; big data analytics, block chain technology, Internet of Things (IoT), AI and cyber domain, AI and cognitive computing, robotics, autonomy, next generation systems and advanced materials for defence applications (Levy, 2020).

1.2.1 Advantages of AI in the Military domain

One major advantage of ML is that it provides military commander with better awareness of situation and provides more time to take decisions (Boulanin, Saalman, Topychkanov, Su, &

Carlsson, 2020). Systems based on AI are able to tell decision makers about the anticipated actions of enemies, which helps policy makers to develop strategies accordingly (Wilner & Babb, 2021). However, AI may also motivate decision makers to delegate tasks to automated machines under time specific constraints (Wilner & Babb, 2021). AI systems are also able to filter unnecessary information and provide only necessary information to the commanding officer (Saalman, et al., 2019). AI is also helpful in analysing huge amount of data because data is increasing at an exponential rate and analysis of data requires new tools (Araya & King, 2022). The pace with which data flow will be so huge that humans do not have time to process the information (Joolen, 2000).

Johnson has argued that AI will result in both strategic balance and imbalance (Johnson J. , The Impact of Artificial Intelligence on Strategic Stability, Escalation and Nuclear Security, 2019). Proliferation of AI will result in strategic balance, because according to analysts, industrial sector which is dedicated for development of AI based systems is controlled by the commercial sector as compared to the state-owned industries, and it will augment the proliferation of AI driven technology and small states will be able to get the benefits of AI and will be able to incorporate AI in their systems and able to coerce the powerful states, which will result in the balance of power (Wilner & Babb, 2021). Increasing autonomy of robots and machines embedded with AI along with AI-related technologies that helps in brain-computer interface will be the *"silver bullets"* as far as future wars are concerned (Rickli J.-M. , 2018). Loss of soldiers will be less because of the deployment of autonomous systems and robots in the battlefield (Garcia E. V., 2021).

1.2.2 AI and Autonomous Systems

AI is widely used in autonomous systems (such systems have autonomy as far as decision making is concerned), and autonomy is defined as *"the ability of a machine to execute a task or tasks, without human input, using interactions of computer programming with the environment"* (Schwarz, 2021). M. L. Cummings, has explained the difference between automated systems and autonomous systems, automated systems are those systems which are very certain and their output will always remain same for input, and autonomous systems are those systems which analyse input probabilistically and they take best possible option and every time they do not give

same output (Cummings, 2017). Other words for automation in Russian military literature are digitalization, intellectualization and robotization (Nadibaidze, 2022). Autonomous systems are of two types, *"autonomous at rest"* which includes systems that are not physical in nature like software, and *"autonomous in motion"* are those systems that have physical existence like drones, both systems will be introduced in future in battlefields (Fukuda, 2020).

For a weapon to be classed as fully autonomous, it must fulfil three functions; searching the objective, decision to engage and finally engagement of target (Rickli J.-M. , 2018). AI also find applications in swarming technology. In swarming technology, multiple drones work in a group (Mian, 2021). Hundreds of drones collect data and many drones guide numerous weapons for different combat roles (Araya & King, 2022).

There are instances when fully automated response systems are needed, like the missile defence systems, such systems are embedded with *"pre-authorized"* mode to counter the incoming missiles (Boulanin, Saalman, Topychkanov, Su, & Carlsson, 2020). Autonomous weapons are also capable of electronic warfare, e.g., Chinese UAV Wing Loong 2 is equipped with *"integrated electronic warfare mission system"* (Dahm, 2020).

1.2.3 Applications of AI in Securing Cyber Space

AI is able to secure cyberspace by mitigating threats arising in the cyber domain. AI helps in limiting the spread of misinformation and detecting misinformation and also help in the detection of deep fakes and detection of activity by bots (Villasenor, 2019). AI has made it easy to diagnose abnormalities in the cyberspace, e.g., in 2016, in Cyber Grand Challenge by DARPA, participants have to develop AI based algorithms that, *"detect, evaluate, and patch software vulnerabilities before [competing teams] have a chance to exploit them"*, detection of abnormalities takes place within seconds (Sayler, 2020).

1.2.4 AI and Evolving Arms Race Between Adversaries

Moreover, Arms race has instigated in the domain of militarization of AI because technology is the feature of major powers (Arif, Militarization of Artificial Intelligence, 2019). Militarization of AI has huge impact for balance of power (Araya & King, 2022). Considering the impact of AI in the military domain, countries are striving for militarization of AI to have leverage as far as

warfare is concerned because geopolitical and economic superiority of countries will depend upon AI capabilities (Levy, 2020).

1.2.5 Disadvantages Associated with the Integration of AI in the Military Domain

In the military domain, AI also has several disadvantages. Unlike other forms of power like economics and military power which are measurable, AI is less measurable (Wilner & Babb, 2021). AI is used to develop deep fakes which are used to deceive (Lodhi, 2022). Ramifications of AI based systems in land, sea, air, cyber and outer space are huge. Applications of AI in hybrid warfare e.g., in disinformation, misinformation, fake news, manipulation of opinion, cyber physical attacks etc., have implications for security and economy (AI brings paradigm shift in modern warfare & state security, moot told, 2022). Hybrid warfare includes propaganda, deception, sabotage and various other non-kinetic military ways to impact adversaries (Araya & King, 2022).

Integration of AI in cyber domain will results in cyber offensive capabilities, and AI will also transform, *"the character of conflict beyond information-age warfare toward 'algorithmic warfare', in the US military's phrasing, or 'intelligentized' warfare, as Chinese military thinkers characterize it"* (Villasenor, 2019). AI based malwares are used for cyber offensive, an example is the computer worm that was used to infect the command-and-control systems of Iranian centrifuges in 2010 (Gatopoulos, 2021). Stuxnet effectively disturbed the strategic stability of Middle Eastern Region and results in physical change as far as Middle Eastern geopolitical landscape is concerned (Hadi, 2020). Since then, cyber arms race has started in the Middle Eastern region. In 2011, Iranian supreme leader gave permission for the establishment of Iran's Supreme Council of Cyberspace (Rickli J.-M. , 2018). Moreover, due to the use of AI based technologies to gain advantage in information domain, 5G Network Centric War (NCW) is gaining importance (AI brings paradigm shift in modern warfare & state security, moot told, 2022).

Moreover, AI based systems depends upon data sets, these data sets if possess any fault, will result in human rights violations (UN calls for moratorium on AI systems that threaten human rights, 2021). Cyber-attacks by adversaries using AI-enabled cyber weapons will be very speedy and a state will have to respond immediately in order to counter it, such state will not have time

to evaluate incoming attack, and constructing an AI-enabled systems will be viable for evaluating such attacks and for taking counter measures (Schmidt, 2022).

Advanced conventional capabilities due to the integration of AI are able to increase the risk regarding inadvertent escalation (Johnson J. , The Impact of Artificial Intelligence on Strategic Stability, Escalation and Nuclear Security, 2019). Technical limitations associated with current iteration of AI based software are also concerning, because they are posing risks to stability and might results in escalation (Johnson J. J., 2020). Also, due to misperception, AI might result in escalation (Johnson J. , The Impact of Artificial Intelligence on Strategic Stability, Escalation and Nuclear Security, 2019). Militarization of AI has huge consequences due to the vulnerabilities of AI based systems and there is growing need for confidence building measures (Garcia E. V., 2021).

Moreover, ASI will transform warfare and international relations and ASI presents huge risk because states will become part of race to develop ASI (Carayannis & Draper, 2022). Remotely operated aerial systems are used in conflict between Russia and Ukraine (Lodhi, 2022). Another issue associated with autonomous systems is that they take decisions without human intervention and LAWS have instigated another arms race (Lodhi, 2022). There are also instances where autonomous cars are unable to work properly being subject to errors (OLIVEIRA & BRAGA, 2020).

1.3 Strategic Stability

Strategic stability means, *"a state of affairs in which countries are confident that their adversaries would not be able to undermine their nuclear deterrent capability' using nuclear, conventional, cyber or other unconventional means"* (Topychkanov, 2020). Strategic stability was first used in Cold war in the context of US and USSR, both these countries justified their possession of nuclear triads as improvement of survivability of their retaliatory force (Boulanin, Saalman, Topychkanov, Su, & Carlsson, 2020). During the Cold War, strategic stability is only restricted to nuclear security, but in the current global nuclear order, strategic stability is characterized by chain character of warfare and conventional and nuclear *'entanglement'* (kulkarni, 2022). According to Edward Warner, strategic stability is used in three ways; most

narrowly, strategic stability is the unavailability of incentives to resort to first strike (crisis stability) and unavailability of incentives to build nuclear force (arms race stability), more broadly, strategic stability tells about absence of conflict between nuclear armed states, most broadly, strategic stability tells regarding regional or global security environment in which states enjoy peaceful relations (Acton, Reclaiming Strategic Stability, 2013).

Initially, only those factors are considered to influence strategic stability that can impact the delivery of first strike or retaliatory strike, as new weapons emerged like non- nuclear strategic weapons, space weapons, precision weapons etc., they are also considered as having impact on strategic stability (Savelyev & Alexandria, 2022).

1.3.1 Strategic Stability During Cold War

Strategic stability during Cold War is materialized due to; '*mutually assured destruction'* which kept the probability of nuclear war low, US and USSR agreed for process to control number of overt offensive nuclear weapons in each other's arsenal; second strike capability's development make it impossible for any side to resort to first strike; confidence building measures (CBMs); system of communication which was established to prevent escalation during crises etc. (Topychkanov, 2020).

Nuclear deterrence worked in case of Soviet Union and US and war was prevented despite both of them (economically, politically, ideologically and militarily) opposed to each other; proxy wars and face-off between US and Soviet soldiers in Central Europe (Pifer, 2015). Initially, Soviet Union and US agreed to maintain *'mutual destruction'* which is the basis of strategic stability and which define strategic stability as the balance of nuclear forces which rules out incentives for any party to launch first strike (Savelyev & Alexandria, 2022). Further, bilateral arms control that originated between US and USSR during the Cold war enhanced global security for half of the century (Trenin, Stability amid Strategic Deregulation: Managing the End of Nuclear Arms Control, 2020).

Another reason which results in preventing war between US and USSR is their military pre-eminence and strategic resources as compared to other states during the Cold war, strategic stability during that period was maintained because of the weakness of their potential rival, China, which prolonged US-USSR bipolarity (Yost, 2011).

1.3.2 Strategic Stability in 21st Century

Nuclear deterrence is the basic reason for stability between nuclear states in the 21st century, but there are some factors that makes global strategic environment more complex as compared to the strategic environment during Cold War, these includes; advancements in technology, doctrinal change to strengthen nuclear deterrence and decrease in psychological barrier that results in strategic restraint during the latter half of 20th century (Trenin, Strategic Stability in the Changing World, 2019).

Next, world order is transforming, China is emerging as a major power, Russia is also a major power despite her struggles, Japan is economically strong, Brazil is also striving for a place as global power etc., all these factors show that global order is transforming towards multi polarity, and due to the transformation of global order, strategic instability is endemic and strategic instability is also affected by social, economic and technological factors (Walton & Gray, 2013). However, due to great power competition, it is highly desirable that strategic stability must exist, in order to reduce the possibility of military conflict and nuclear escalation (Ford, 2020). Moreover, absence of bilateral arms control is a major issue, unlike Cold war, bilateral arms control is being replaced by nuclear deregulation in a polycentric world (Trenin, Stability amid Strategic Deregulation: Managing the End of Nuclear Arms Control, 2020). Despite these changes, significance of nuclear element of deterrence will remain, because the deterrent, operational and political impact of nuclear means will not be matched by the deterrent, political and operational impact of conventional power (Yost, 2011).

1.4 Instruments of Strategic Stability

Strategic stability between countries is impacted by many factors which directly and indirectly contributes toward instability and impact the peaceful fabric. Before the nuclear age, e.g., sword, fortifications, nerve gas, gun powder, machine gun, radio, tank, aircraft, submarine, radar etc., have impact on stability (Lehman II, 2013). Now, developments regarding AI etc., will able to impact stability (Enhancing Strategic Stability in Southern Asia, 2022). Various elements which have impact on strategic stability are as follows:

1.4.1 Nuclear Deterrence and Strategic Stability

Nuclear deterrence is the basis of strategic stability (Trenin, Stability amid Strategic Deregulation: Managing the End of Nuclear Arms Control, 2020). Nuclear weapons are suited for deterrence, and their retaliatory use prevents aggressor from aggression, deterrence creates a situation in which the cost associated with the aggression outweigh the benefits aggressor wanted to achieve, this is due to the immense destructive power of nuclear weapons, e.g., in early 1960s, US was close to building nuclear triads; strategic bombers, intercontinental ballistic missiles (ICBMs), submarine launched ballistic missiles and Soviet Union started building nuclear triads in mid 1960s, nuclear deterrence was evolved when both these states acquired enough capability to inflict damage even after facing first strike (Pifer, 2015). So, effectiveness of deterrence depends upon second strike capability and retaliatory power, e.g., certainty of annihilation prevents Russia and US from engaging in hostilities in situations in which the two countries are against each other (Trenin, Stability amid Strategic Deregulation: Managing the End of Nuclear Arms Control, 2020). This is also known as *"mutually assured destruction",* the aspects of mutually assured destruction are credible minimum deterrence and no first use policy; credible minimum deterrence is the possession of minimum nuclear weapons that deter enemy from using nuclear weapons and no first use policy means that a state will not resort to the use of nuclear weapons until the use of nuclear weapons by enemy (Topychkanov, 2020).

1.4.2 Conventional Capability and Strategic Stability

During Cold War, strategic stability was maintained by nuclear weapons (Jilani, 2019). Now, loss of conventional capability is also able to impact strategic balance. For example., conventional military forces of Russia have weakened in its war with Ukraine, which increases the chances of Russia's resort to nuclear weapons as far as Russian military planning is concerned (NATIONAL SECURITY STRATEGY, 2022).

1.4.3 Technology as an Instrument of Strategic Stability

Technology has significant impact on strategic stability. Advancements in technology creates imbalance between rivals. Countries are investing at an increasing rate in modern technologies in order to materialize advancements in their military platforms because technology has significant impact as far as defence sector is concerned. Also, states which possess advanced systems will

have advantages. Under current circumstances, *'technological control'* is equally important for strategic stability as traditional approaches to arms control are important (Ford, 2020).

(a) Space Based Systems and Strategic Stability

Development of anti-satellite weapons by states is a major challenge. Through anti-satellite weapons, satellites of opponents are vulnerable as far as manipulation is concerned and warning systems regarding missile attack are also vulnerable to manipulation with anti-satellite weapons (Trenin, Strategic Stability in the Changing World, 2019). Further, proliferation of smaller satellites is able to overcome the vulnerabilities of bigger satellites because they will provide backup for communication purposes and low-resolution earth imaging, but such smaller satellites also pose dangers due to the proliferation of anti-satellite platform (O'Hanlon, 2018).

1.4.4 Cyber Space and Strategic Stability

Cyber-attacks are also concerning. Strategic significance of cyber-attack can be governed by the US attack on Iranian centrifuges. Stuxnet virus was developed by both USA and Israel for not only to destroy Iranian centrifuges but also to restrict the operators from determining the cause of failures by providing false data on monitoring systems (Acton, Cyber Warfare & Inadvertent Escalation, 2020). Civilian infrastructure of states like, electric grids etc., are also vulnerable to cyber-attacks and it is very difficult to find out the source of such attacks with certainty, due to this it also makes states vulnerable (Trenin, Strategic Stability in the Changing World, 2019).

Cyber-attacks are also able to impact diplomatic relations between states. One such example is the suspension of diplomatic ties between Albania and Iran. Albanian government websites and services were attacked on 15 July 2022 (Albania cuts ties with Iran over 'cyberattack', 2022). Moreover, attrition technologies like transistors, vacuum tubes, micro-chips that have transformed war and weapons are able to impact strategically only because of their vulnerability to cyber-attacks and electromagnetic pulses in case of nuclear weapons (Lehman II, 2013).

1.4.5 Inadvertent Escalation and Strategic Stability

One major factor which contributes toward strategic imbalance between countries is the chance of accidental attack and failure of system. On 26 Sep, 1983, Soviet early warning systems reported US ballistic missile launchers, instead of alerting his chain of command for counter

action, duty officer Stanislav Petrov considered the alarm to be false and reported malfunctioning (Pifer, 2015). In 1980, in US, *"Failure of a computer chip within a line multiplexer (Nova 840 computer) of the NORAD Control System caused false missile warning data to be transmitted to Strategic Air Command, the National Command Center, and the National Alternate Command Center."* (Pifer, 2015). Next, warhead ambiguity also results in escalation, because nuclear and conventional weapons are deployed from same platforms, and chances of nuclear retaliation increases if conventional weapons will be confused for nuclear weapons (Trenin, Strategic Stability in the Changing World, 2019).

1.5 Strategic Stability in South Asia

In the context of South Asia, three nuclear powers Pakistan, China and India coexist with complex geopolitical environment characterized by increasing nuclear stockpiles, advanced weapons platform etc., and it is unlikely that any of these states deliberately resort to nuclear weapons, and new disruptive technologies like; drones, precision-based munitions, cyber technologies, anti-satellite systems, hypersonic systems etc., increase strategic risks between the two dyads, India-Pakistan and India-China, so in South Asia, strategic stability is affected by precision-based munitions, armed drones and space-based weapons (kulkarni, 2022).

Stability and security in South Asia depend upon the effectiveness of nuclear deterrence and strategic stability (Topychkanov, 2020). Relations between India and Pakistan are stabilized due to nuclear capability (Pakistan cannot ignore militarization of space and AI by India: Officials, 2021). However, strategic stability is not only restricted to the non-conventional warfare rather it can also be disturbed by the conventional asymmetry (Jilani, 2019). Developments in domain other than traditional military domain like, ML, AI, offensive capabilities in cyber and space domain are able to disturb strategic stability in the future (Enhancing Strategic Stability in Southern Asia, 2022). Several factors like; conventional asymmetry between India and Pakistan, Indian nuclear posture, Indian endeavours regarding offensive military modernization etc., contributes to strategic instability in the region, also, technological development by India in the domain of anti-satellite weapons, ballistic missile defence, hypersonic technology, nuclear powered submarines etc., have impact on strategic stability (Malik, 2020).

Chapter no 2

Militarization of AI: An Overview

AI has revolutionized military domain. It find numerous applications in military domain. However, there are many security related issues associated with the integration of AI in various systems. In this chapter, impact of AI on technological advancements is discussed. Discussion is also substantiated with response from experts in the field of AI, cyber security, information and communication systems, integrated circuits, avionics and strategic stability.

2.1 Role of AI in Advancing Military Systems

Özdemir has maintained that, AI cannot be considered as military innovation, it is an enabler which enable innovations in military domain and it has applications in all domains; land, sea, air, cyber and space (Özdemir, 2019). According to a respondent, AI assists traditional systems and enhances their efficiency and effectiveness (personal communication, October 7, 2022). In the military domain, AI has huge impact in cyber warfare, biotechnology, aerospace (Szabadfoldi, 2021), logistics, autonomous systems etc. (Özdemir, 2019). AI is helpful in computer vision, learning and reasoning (personal communication, September 29, 2022). According to a respondent, AI is useful regarding simulation, virtual (augmented) reality (personal communication, September 29, 2022). Moreover, ML and autonomy are able to increase the effectiveness of present systems, but such technologies cannot be construed as a comprehensive solution (Roy, 2020).

AI has huge importance regarding decision making (personal communication, October 25, 2022). AI as a technological tool will help in target acquisition, estimation, guidance systems etc. (personal communication, October 25, 2022). According to an expert, with AI, target acquisition will be with high precision and chances of collateral damage are minimum and systems will operate with high speed, accuracy and their response will be quick (personal communication, October 11, 2022).

2.1.1 Applications of AI in Intelligent Robots

AI is finding applications in robots and various other autonomous platforms at an increasing rate. According to Bartneck et. al, autonomous robots find applications in; missions related to supply

and resupply, mine clearing, command and control, intelligence, rescue, disposal of explosive ordnance etc. (Bartneck, Lütge , Wagner, & Welsh, 2021). Robots are effective in dangerous environments because it will prevent the dangers associated with humans (personal communication, September 29, 2022). For Example., Groundhog is a robot which pass over underground mines in order to reduce the dangers associated with humans (Brunette, Flemmer, & Flemmer, 2009). Moreover, AI based robots are helpful in disaster management in case of natural calamities (Ahmad, Amir, & Ahmad, 2019).

2.1.2 AI and Autonomous/Unmanned Systems

In autonomous systems, AI find applications regarding surveillance, tracking and localization (personal communication, September 29, 2022). Drones embedded with cameras and integrated with AI will be more precise, accurate and efficient in detection (personal communication, September 29, 2022). Autonomous Underwater Vehicles (AUV), are effective for mines detection etc., deep neural networks (DNN) find applications regarding image classification which helps in automatic mines detection (Svenmarck, Luotsinen, Nilsson, & Schubert, 2018). UAVs also find applications regarding mapping (personal communication, October 11, 2022).

2.1.3 AI and Surveillance

In surveillance, AI is of huge importance. Surveillance systems based on AI are very efficient and not prone to errors unlike traditional systems (personal communication, October 12, 2022). According to an expert, AI based systems trained on a large number of images are effective in surveillance i.e., in detecting movement of enemy's personal (personal communication, October 12, 2022). According to another expert, AI will aid in information gathering and Intelligence (personal communication, October 11, 2022). Svenmarck et. al, has described that one major application of AI is in maritime surveillance. Through ML generated normality model, vessel movement is analysed, movement of vessel tells about whether its threatening or not (Svenmarck, Luotsinen, Nilsson, & Schubert, 2018).

2.1.4 Application of AI in Logistics

AI has significant impact regarding logistics and transportation (personal communication, September 28, 2022). In military logistics, internet of things (IoT) is beneficial in logistics management, it enhances speed and shortens response time (Bistron & Piotrowski, 2021).

According to a respondent, vehicles powered by AI are able to provide logistical support to military units deployed in field (personal communication, September 28, 2022). AI based vehicles are able to operate in dangerous environments too, because under uncommon circumstances there will be no loss to the lives of soldiers (personal communication, October 11, 2022).

2.1.5 Role of AI in Remote Sensing and Geographical Information Systems (GIS)

According to a respondent, AI will be helpful in remote sensing and geographical information systems (personal communication, October 12, 2022). In the military domain, GIS find applications regarding analysis of terrain, intelligence gathering, cartography, monitoring of terrorist activity etc. (Satyanarayana & Yogendran, 2009). Due to integration of AI, remote sensing will be fully autonomous (personal communication, September 29, 2022). AI is also helpful in early warning systems (personal communication, September 29, 2022). Moreover, AI find applications in sensing chemical hazards, environmental emissions and in monitoring weather (personal communication, October 12, 2022).

2.1.6 Applications of AI in Voice and Image Recognition

AI helps in recognition of voice and human natural language, systems comprehend human natural language and transform the natural language into a form which is compatible for processing by computer, in order to perform specific tasks (Ahmad, Amir, & Ahmad, 2019). One major application of ML is in image recognition (Sarker, 2021). AI based systems detect enemy troops movement based on their training on huge data (personal communication, October 12, 2022). Moreover, AI will aid in satellite-based monitoring of opponents (personal communication, October 7, 2022). ML also find application in recognition of patterns (Sarker, 2021).

2.1.7 Military Communication Systems and AI

AI has applications in radar systems, Internet of Things etc. (personal communication, September 29, 2022). According to an expert, in the communication domain AI is finding applications in radars. Such systems will get modified by AI and their detection capabilities are enhanced (personal communication, September 29, 2022). AI helps in improving signal processing and image processing capabilities of radar (personal communication, October 12,

2022). According to a respondent, signal processing capabilities help in surveillance in boundary regions (personal communication, October 11, 2022). According to a respondent, AI also find applications in frequency hopping spread spectrum (FHSS). AI based systems are used to attack enemies' systems to detect FHSS, and AI is also helpful in materializing measures against such attacks (personal communication, October 11, 2022).

2.1.8 AI and Decision Making

AI assist humans in decision making (personal communication, October 11, 2022). It is also useful in decision support (personal communication, October 7, 2022). Humans are not able to process information in milli seconds but systems based on AI are able to process information in milli seconds and with accuracy (personal communication, September 29, 2022). AI based systems learn from patterns of data (personal communication, September 29, 2022). Such systems make inferences from data which helps in better decision making (personal communication, October 11, 2022). Explainable AI tells decision makers about decision strategy (personal communication, September 29, 2022). Humans will decide about their actions based on the recommendations of AI based systems (personal communication, October 7, 2022).

2.1.9 Applications of AI in Cyber Security

Security of military information systems is of huge importance. AI helps in cyber security and information security (personal communication, October 11, 2022). Abnormalities in cyber domain are able to bring huge consequences. AI based systems help in recognizing hackers and abnormalities arising in the systems due to intruders, and are able to take counter measures against attacks (Ahmad, Amir, & Ahmad, 2019). One major issue in cyber domain is intrusion. Intrusion Detection Systems are deployed to detect normal and abnormal traffic, AI and ML will be helpful in making the response of such systems more accurate (Svenmarck, Luotsinen, Nilsson, & Schubert, 2018). ML continuously learn from analysis of data and help better detection of malwares and suspicious activity (Sarker, 2021).

2.1.10 Application of AI in Information Domain

AI is deployed to generate deep fakes, deep videos by conspirators (personal communication, September 29, 2022). In a report by Congressional Research Services (CRS), it is maintained by author that deep fakes were detectable but in the future due to technological advancements deep

fakes may remain undetected in forensic analysis (Sayler, 2020). According to an expert, in the information domain, AI is employed in both defensive and offensive ways. AI based systems are deployed by manipulators to materialize misinformation and disinformation campaigns. On the other hand, systems based on AI are able to detect misinformation and disinformation attacks (personal communication, October 11, 2022). Moreover, neural networks find applications in differentiating between information tweets containing facts and non-information tweets containing rumours (Bistron & Piotrowski, 2021).

2.2 Role of Data in the Development of AI Based Systems

According to a respondent, accuracy of AI based systems will increase with the passage of time. For training of AI based systems, data is of primary importance, data set must continuously increase, because neural networks rely on data. Increasing data set will help better systems and results in improvements regarding the accuracy of AI based systems (personal communication, October 11, 2022). In future, simulators for training will also be based on AI (personal communication, October 7, 2022). Quality of data on which AI based systems are trained is very important, AI based systems use large amount of data, therefore, data must be reliable, correct, accurate and of high quality, if the data is of poor quality the results will be faulty (Eggers & Sample, 2020).

2.3 Vulnerabilities Associated with AI based Systems

There are many issues associated with modern technological tools. These issues are related with privacy and security compromise (Lodhi, 2022). Massive speed of AI based systems in combat will result in machines to surpass humans physical and cognitive abilities (Johnson J. , The Impact of Artificial Intelligence on Strategic Stability, Escalation and Nuclear Security, 2019).

2.3.1 Security Issues Associated with AI Based Systems

According to a respondent, AI based systems are vulnerable. There are issues regarding manipulation. There are chances of malfunctioning, software failure or sensor failure (personal communication, September 29, 2022), because AI based systems are complex and they involve

huge amount of data, and AI based systems will get deteriorated by adversarial attacks (personal communication, October 7, 2022). For security of data, algorithms need to get updated (personal communication, October 11, 2022).

AI based systems have the potential to defeat conventional defence systems, but such systems are vulnerable and prone to hacking and used by non-state actors (Sayler, 2020). Also, AI and ML has uses in information warfare i.e., to spread disinformation to deceive enemies and misinformation (proliferation of false information without the intent to deceive) (Artificial intelligence and machine learning in armed conflict: A human-centred approach, 2019).

Next, AI can be used to develop deep fakes (swapping one person's face by another), which will be used for shifting narrative and perception in society (Wilner & Babb, 2021). Deep fakes can be used to produce false news, influence public discourse and manipulate information (Sayler, 2020). Moreover, people that are working on developing deep fakes are 100-1000 times more than those that are striving to detect deep fakes (Johnson J. , The Impact of Artificial Intelligence on Strategic Stability, Escalation and Nuclear Security, 2019).

Advancements in AI have enhanced the applications of AI in many domains like; image captioning, video synthesis and lip reading etc. (Svenmarck, Luotsinen, Nilsson, & Schubert, 2018). It is mentioned in a report published in 2020, that another major vulnerability associated with AI based systems is data poisoning (algorithms can be attacked and reprogrammed which results in insecurity of information regarding the model, it results in the development of sophisticated attacks known as data poisoning) (Eggers & Sample, 2020). However, AI and ML also help in cyber domain in intrusion detection i.e., detection of malicious activity (Svenmarck, Luotsinen, Nilsson, & Schubert, 2018).

Next, based on human-machine interaction, LAWS can be divided into three categories, LAWS in which humans are; out of the loop, on the loop and in the loop, means; fully autonomous systems, supervised autonomous and semi-autonomous (Araya & King, 2022). Due to the integration of AI, such systems are vulnerable to hacking, malfunctioning, sensor failure and software failure, therefore, for safety and security reasons, decisions must not be delegated to fully autonomous systems (personal communication, September 29, 2022). Therefore, final decision making must be in the hands of humans (personal communication, September 29,

2022), and use of AI in autonomous systems must be cross checked by international bodies to govern their compliance with international law (personal communication, October 12, 2022).

According to a respondent, there are security related issues with AI based systems due to vulnerabilities (personal communication, October 7, 2022). Quantum computing will solve security related issues associated with AI based systems, it will make systems regarding information and communication technologies not vulnerable to hacking (Rugge, 2019).

Conclusion

AI has applications in the field of logistics, surveillance, mapping, localization, intelligence, decision making, communication systems, cyber security and information security, remote sensing and geographical information systems etc. It also find applications in the domain of robotics and autonomous systems. AI is also helpful in communication and information domain. AI also helps in decision making. On the other hand, AI based systems are vulnerable. AI based systems have huge security related issues. For proper and secure functioning of such systems, it is important that they must be secure.

Chapter no 3

Militarization of AI and Strategic Stability

In this chapter, impact of militarization of AI on strategic stability is discussed from the global perspective. Also, impact of militarization of AI on various instruments of strategic stability is also discussed.

3.1 Impact of Militarization of AI on Strategic Stability

AI as a technological revolution has significant impact on the performance of systems in which it is integrated. AI based weapons are those weapons that "utilise AI to pursue, distinguish, and destroy enemy targets automatically; often composed of information collection and management systems, knowledge base systems, decision assistance systems, mission implementation systems, etc." (Aryan, 2021). AI based systems are able to revolutionize military domain. As strategic stability is maintained through conventional, nuclear, cyber and other non-conventional means (Akiyama, 2021), states that have leverage regarding cyber domain and militarization of AI, will have advantages over those which lags behind in materializing integration of AI in military platforms. Also, AI, big data, hypersonic aerial vehicles, quantum computing, autonomous systems etc., will have strategic influence in the next 20 years and will go through rapid development (Szabadfoldi, 2021).

3.1.1 Militarization of AI and Nuclear Deterrence

The path of AI development along with information technologies and other technologies have impact on security (Akiyama, 2021). Integration of AI in military platforms will enhance conventional power and will create imbalance between adversaries. According to a report by Stanley Centre, there are three major risks posed by AI to deterrence; AI will increase the chance of misperception, it undermines deterrence because states may perceive that their adversaries will use AI based platforms to attack their command and control systems and integration of AI in nuclear decision making results in increase in risks for accidents (Sisson, Spindel, Scharre, & Kozyulin, 2020).

3.1.2 AI, Conventional Capability and Strategic Stability

AI based systems are able to transform defence sector. Such systems are able to ameliorate existing capabilities to a great extent. AI based systems like, drones, UAVs etc., are able to disturb balance between adversaries. Due to these reasons, they are concerning for strategic stability. Also, lack of regulatory mechanism regarding lethal autonomous weapon systems, further aggravates situation.

(a) Autonomous Systems and Strategic Stability

Advancements regarding robots and autonomous systems will be of great advantage for states. These technological innovations are important not only for the security sector but for non-security sector also. M. L. Cumming, has maintained that research & development regarding autonomous systems is happening globally and countries are striving for various autonomous systems like autonomous underwater and autonomous ground vehicles (Cummings, 2017). Automated systems (unmanned aerial vehicles (UAVs), unmanned surface vehicles (USVs) and unmanned underwater vehicles (UUVs)) will enhance reconnaissance capabilities (Boulanin, Saalman, Topychkanov, Su, & Carlsson, 2020). UAVs will be the backbone of air force in the future (Saalman, et al., 2019). Autonomous systems have applications in both defensive and offensive domains. For example, Patriot missile system, Phalanx weapon system and AEGIS weapon system are defensive systems, while, Harpy is an offensive system (Bartneck, Lütge , Wagner, & Welsh, 2021). British dual-mode *"Brimstone guided missile"* is embedded with algorithms that are responsible for autonomy in selecting target (Rickli J.-M. , 2018).

Drones that are fully autonomous are already developed by countries and militaries of about 100 countries have armed and unarmed drones (Araya & King, 2022). States are also able to transform combat drones into autonomous drones with *"pattern-recognition algorithms"*, such drones are accessible to all states, and have impact on strategic stability (Rickli J.-M. , 2018).

3.1.3 Militarization of AI and Arms Race

Militarization of AI has started an arms race between US, Russia and China etc. (Burton & Soare, 2019). The country which leads in AI related developments will have superiority over others in terms of traditional war and cyber war, also, geopolitical and economic superiority of countries will depend upon AI capabilities (Levy, 2020). Military spending on AI will reach $18

billion globally by 2025 (Mian, 2021). According to Levy, many states have prioritized militarization of AI, among them US is leading in AI capabilities, followed by China and then UK (Levy, 2020).

Modern technologies have transformative impact on warfare, US and her allies are investing in modern technologies as well as their applications in space domain, AI, cyber domain, quantum systems etc., US will also strive to overcome issues in joint capability development (NATIONAL SECURITY STRATEGY, 2022). Wyatt et. al, has written that under *"Third Offset Strategy"* AI became priority for US, which aims to enhance advanced technologies in order to counter conventional capabilities of China and Russia (Hoffman & Kim, 2023).

According to congressional research report, 600 AI based projects are active under the US DOD and unclassified investments by DOD regarding AI in FY2021 were $2.5 billion as compared to $600 million in FY2016 (Sayler, 2020). US has maintained in NSS 2022, that it will work with allies to harness latest technologies including AI, quantum technologies, microelectronics, advanced telecommunications etc. (NATIONAL SECURITY STRATEGY, 2022). White House is also launching an initiative, US-India initiative on critical and emerging technologies, which includes cooperation in the field of AI, semiconductors etc., to counter China, it also includes cooperation in space domain and quantum computing (US, India partnership targets arms and AI to compete with China, 2023).

China is also striving to become major AI country by surpassing US (Dahab, 2019). Sayler has maintained that China's developments regarding military AI are motivated by the innovation plans of US in the defence domain (Sayler, 2020). AI will be the enabler of future military capabilities of China, AI will result in military revolution because of changes in operational style etc. (Kania, Battlefield Singularity: Artificial Intelligence, Military Revolution, and China's Future Military Power, 2017). The concept of revolution in military affairs (RMA) was originated in 1950s, and explained by Charles Townshend as: *"the product of three distinct kinds of change: administrative, technological and ideological"* (Neuneck & Alwardt , 2008).

People's Liberation Army (PLA) of China, considers the militarization of AI, cloud computing and big data etc., as a transition from *"informatized warfare"* to *"intelligentized warfare"* (Kim, 2021). China is advancing in swarming intelligence, in 2016 a Chinese private company showed

a formation of 67 small UAVs with coordination and communication between them (Kania, Battlefield Singularity: Artificial Intelligence, Military Revolution, and China's Future Military Power, 2017). Another example of swarming is the swarm of 1180 quad copters that flew in Guangzhou in 2017 (Morgan, et al., 2020). Moreover, New Generation AI Developmental Plan was released by China in 2017, according to this plan, China will further three-dimensional agenda regarding AI, which includes; tackling issues in R & D, pursuing variety of applications & products and enhancing AI industry by 2030 to 1 trillion RMB (Kania, Battlefield Singularity: Artificial Intelligence, Military Revolution, and China's Future Military Power, 2017).

Next, Russia has released national Strategy for AI to enhance AI expertise etc., over next 5 and 10 years, Russia is also exploring the applications of AI regarding the swarming technology and adaptive frequency hopping, it has also created an organization for robotics and autonomy, *"Foundation for Advanced Studies"*, but Russian advancements in AI lags behind US and China (Sayler, 2020).

3.1.4 Militarization of AI and Inadvertent Escalation

AI technology along with various technologies that are enabled by AI like; hypersonic technology, robotics, remote sensing etc., aggravates destabilizing impact of these technologies used by nuclear-armed rivals and will open new pathways for vertical and horizontal inadvertent escalation (Johnson J. , Inadvertent escalation in the age of intelligence machines: A new model for nuclear risk in the digital age, 2022). Systems based on AI etc., are vulnerable to attacks from hackers and faulty AI systems also generate false alarms (personal communication, September 29, 2022). According to an expert, UAVs and other unmanned vehicles are vulnerable, there are chances of malfunctioning, software failure ad sensor failure (personal communication, September 29, 2022). Also, there are limitations associated with AI based systems, e.g., current AI based systems are unable to operate beyond their role for which they are trained etc. (Akiyama, 2021). Next, measure of transparency, effective communication, contacts and restraint among parties are instruments that are effective to prevent inadvertent collision which leads to escalation (Trenin, Stability amid Strategic Deregulation: Managing the End of Nuclear Arms Control, 2020).

3.1.5 Integration of AI in Cyber Domain and Strategic Stability

"Cyber terrorism", poses a huge threat to national as well as global security (Khory, 2006). In the cyber domain, AI can be used in two ways; to materialize cyber-attack and to counter cyber-attack, because cyber-attacks are able to render grave disadvantages and due to high speed of decision making, human control will lessen and vulnerabilities like hacking etc., will increase (Altmann, 2020). According to a respondent, anything which is connected with internet is vulnerable, same is the case with AI based systems, if they are connected with internet (personal communication, October 7, 2022). On the other hand, there is a need for the integration of AI to secure defence against cyber-attacks, because activities on internet requires the analyses of huge amount of data to take decisions, analyses of such big amount of data is beyond the human's ability (Tyugu, 2011). Traditional cyber security tools materialize cyber defence by finding matches to the existing malicious codes, so hackers need little modifications to avoid cyber defence, on the other hand, AI based systems detect problems in *"broader patterns of network activity"* and offer more resistance to attack (Sayler, 2020).

AI also find applications regarding the generation of malwares using synthetic data, such offensive cyber weapons need not to rely on human operator rather they plan attack of malware autonomously (Rickli J.-M. , 2018). Current AI approaches are materialized using ML (United Nations Activities on Artificial Intelligence (AI), 2018). ML depends upon mathematical algorithms that find patterns from data sets, adversaries are able to deduce algorithms if they are able to see inputs and outputs of AI based systems (Szabadfoldi, 2021). Also, algorithms and data sets are vulnerable to manipulation, so, AI find applications to *"create and control cyberweapons"* (United Nations Activities on Artificial Intelligence (AI), 2018).

3.1.6 Issues Associated with Militarization of AI and Strategic Stability

There are many issues associated with AI based systems that are concerning for security and stability. Manipulation of cyber space for malicious purposes will plague peaceful fabric.

(a) Generation of Deep Fakes and Stability

Use of AI for malicious purposes like; the generation of deep fakes (swapping a person's face with another person's face) and audio manipulation is creating challenges (Rickli J.-M. , 2018), because deep-fakes and deep-speeches will be used for conspiracies (personal communication,

September 29, 2022). Moreover, such fake audios, videos and photos created using AI will also be used for *"influence operations and blackmail"*, and with advancements in technology, deep fakes will be able to evade forensic analysis tools (Sayler, 2020).

(b) Adversarial Machine Learning and Strategic Stability

Adversarial ML is also concerning for security because attackers find weaknesses in AI based systems and try to exploit them, these attacks are undetectable as far as humans are concerned, such attacks happen during the deployment stage or the development stage of AI based systems through providing *"poisonous data"* as input (Araya & King, 2022). With the manipulation of input data, deep neural networks can be fooled, attackers are able to manipulate systems by generating opposing commands, which can be dangerous (OLIVEIRA & BRAGA, 2020). With generative adversarial networks, attackers manipulate the systems of adversaries and deceive their defence platforms (Rickli J.-M. , 2018).

3.1.7 AI and Silicon Chips

Silicon chips find applications in supercomputing systems, countries require them for development of military technologies (US aims to hobble China's chip industry with sweeping new export rules, 2022). Silicon chips have strategic significance for the deployment and development of AI systems related to the security sector (Khan S. M. & Alexander , 2020). Also, semiconductors are important in modern electronics like; automobiles, smart phones and supercomputer (Lodhi, Compete and contain, 2022). Advancements in AI chips and related hardware will improve processing and analytic capabilities (Kania, Chinese Military Innovation in Artificial Intelligence, 2019).

US has imposed restriction regarding the export of US material which aids in the development of chips to China, US regulations will restrict export of US equipment to Chinese chip makers (US aims to hobble China's chip industry with sweeping new export rules, 2022). Such restrictions will impact Chinese semiconductor industry (Lodhi, Compete and contain, 2022). Further, China is dependent on US EDA software and companies in China incorporates Western IP cores in their design, due to this dependency of China on US technology, US and her allies have competitive advantage as far as production of leading-edge AI chips is concerned, maintaining

competitive advantage in this domain is important for US and her allies (Khan S. M. & Alexander , 2020).

Conclusion

In order to gain advantage, countries are investing in AI based systems at an increasing rate. Military applications of AI have started an arms race between countries because of strategic significance of AI and other emerging technologies. Integration of AI results in improvement in the capabilities of systems. Integration of AI also has impact on conventional capabilities. Moreover, indigenization of silicon chips is important for countries to have advantages as compared to their rivals, because such chips are highly important for the functioning of multiple systems. On the other hand, integration of modern technologies in systems will increase chances of inadvertent escalation. Such issues if materialized are able to increase strategic instability.

Chapter no 4

Militarization of AI and Strategic Stability in South Asia

This chapter focuses on the impact of militarization of AI and technological advancements regarding cyber-space and space-based systems by India on strategic stability in South Asia. It also focuses on developments by Pakistan to foster stability in the region.

4.1 Militarization of AI and Nuclear Deterrence in South Asia

The aim of Pakistan's nuclear program is to deny any benefit to India regarding the initiation of conventional or nuclear war (PAKISTAN, 2022). It is written in a report published by US institute of peace, that advancements in AI, ML, space related technologies and cyber capabilities have the potential to erode strategic stability in the future (Enhancing Strategic Stability in Southern Asia, 2022). Moreover, disruptive technologies e.g., quantum computing, hypersonic glide vehicles, swarming technology, space technology etc., will able to significantly impact international order in next 5-10 years (Villasenor, 2019).

According to a respondent, increasing integration of AI in military platforms by India is concerning for regional stability (personal communication, October 27, 2022), but kinetic operations between Pakistan and India are very sensitive, they will gradually escalate and conventional asymmetry is only able to undermine nuclear deterrence in case of loss of conventional power to a great extent (personal communication, September 28, 2022).

4.2 Militarization of AI by India and Its impact on Strategic stability in South Asia

According to a respondent, increasing integration of AI by India is concerning for strategic stability in South Asia (personal communication, October 7, 2022). Indian advancements in the field of AI are able to start another arms race in South Asia (Rafiq, 2020). According to an expert, integration of AI by India in military platforms like, drones and air defence systems etc., are also concerning for regional stability (personal communication, October 25, 2022). India is also investing in AI based submarines (personal communication, October 25, 2022). Such endeavours will not bode well for stability. This is due to Indian nefarious designs, e.g., Indian

submarines have conducted numerous violations of Pakistan's maritime boundary (personal communication, September 28, 2022).

(a) Militarization of Space by India and Strategic Stability in South Asia

India is also making advancements in the space domain. India has conducted test of anti-satellite weapon in 2019 which is a concern for Pakistan (Concern voiced over militarisation of space and artificial intelligence by India, 2021). DG arms control and disarmament at Pakistan's foreign office, has maintained that, *"militarization of frontier technologies like A.I, cyber warfare, space technologies and quantum computing were casting their dark shades in the region"* (Pakistan cannot ignore militarization of space and AI by India: Officials, 2021).

(b) Impact of Indian Strategic Partnership with Major Arms Producers on Strategic Stability in South Asia

India has advantages due to her international linkages with US, Russia etc., (personal communication, October 25, 2022). Indian advancements in the field of AI and Indian strategic partnership with other countries is concerning for strategic stability in South Asia (Rafiq, 2020). India has made deals with US and Israel regarding various weapons to augment indigenous capabilities (Masood, 2021). India is also getting weapons from France (personal communication, October 25, 2022). From 2008 to 2017-18, India was the largest importer of arms in the world, during 2008 – 2018, total Indian imports regarding arms from US were 15 per cent, during the same period, India imported 62 per cent of her arms from Russia and 11 per cent of total arms from Israel (Kamran, 2020).

4.2.2 Manipulation of Cyber Space by India and Strategic Stability in South Asia

AI has applications in cyber-attacks i.e., in materializing misinformation and disinformation campaign and in defending against such attacks (personal communication, October 11, 2022). India is manipulating cyber space in order to further her intentions. India is waging 5th generation war, cyber war and hybrid war against Pakistan. Militarization of AI by India will further aggravate the situation which will be concerning for strategic stability of South Asia (personal communication, October 7, 2022).

(a) Misinformation and Disinformation Campaign and 5th Generation War by India

India is using modern technologies for offensive purposes. International organizations have highlighted Indian disinformation campaign against Pakistan (Khan A. , 2021). Moreover, along with misinformation and disinformation campaign against Pakistan, India is supporting cyber-attacks and proxy militias, the purpose of this propaganda campaign was to influence international bodies like EU and UNHCR against Pakistan (Bano, 2021). Therefore, increasing integration of AI by India is concerning for peaceful fabric of the region (personal communication, October 7, 2022), because in future, countries will focus on AI and information warfare, kinetic engagements will be less and tactics will be employed to weaken enemy through other means (Masood, 2021).

According to a respondent, India is advancing in AI, 5th generation war etc., India is employing 5th Gen war against Pakistan, India is using tactics to manipulate latest technologies for her nefarious intentions, which is concerning for strategic stability in South Asia (personal communication, September 29, 2022). Pakistan needs to prepare accordingly to counter Indian 5th Gen war (personal communication, September 28, 2022).

4.2.3 Silicon Chips and South Asian Stability

With the increase in reliance on information and communication technologies and electronic systems, silicon chips have gained importance. Considering Indian nefarious activities regarding the manipulation of cyber space, 5th generation war against Pakistan, developments by India in this domain are concerning as far as strategic stability in South Asia is concerned.

According to a respondent, due to indigenization of silicon chips, India will advance in the development of digital hardware like computers, smart phones etc., indigenization of silicon chips also helps in construction industry i.e., in the construction of drones, UAVs, delivery systems, missile platforms etc., and gave them advantage. Increasing indigenization of silicon chips in India will multiply all the technologies related with AI and availability of indigenized chips also impact applications of AI in many domains like; weapon systems, development of weapons, deployment of weapons, information collection, surveillance, intelligence gathering, cyber warfare, information warfare, media warfare, 5th generation warfare, hybrid warfare etc. (personal communication, September 28, 2022).

4.3 Militarization of AI, Pakistan and South Asian Strategic Environment

In order to cope with the challenges, developments in the domain of AI are necessary. According to a respondent, Pakistan has close eyes on Indian developments and Pakistan is also developing systems to compete with India and Pakistan will act to balance the strategic environment of South Asia (personal communication, September 28, 2022). According to an expert, Pakistan is keeping pace with India in the domain of AI (personal communication, October 7, 2022). Director General Arms Control and Disarmament Division at Foreign Office has maintained that Pakistan is technologically well versed and needs to remain active regarding such technologies which are disturbing strategic stability in south Asia (Pakistan cannot ignore militarization of space and AI by India: Officials, 2021).

4.3.1 AI and Cyber Security in Pakistan

Integration of AI in cyber domain for defensive purposes will enhance cyber security, because in cyber domain, AI based systems are able to detect cyber-attacks, manipulation of cyber space and misinformation and disinformation campaign (personal communication, October 11, 2022). Considering the importance of cyber space and instability in the region, Pakistan has taken several initiatives to enhance cyber security and to balance stability in the region.

(a) Initiatives by Pakistan Regarding the Security of Cyber Space

National Cyber Security Policy was approved in 2021, which maintains that a cyberattack against any institution of Pakistan is considered aggression against national sovereignty and all retaliatory steps will be taken, it also maintains that in case of any incident the government will lead response with the support of private and public sectors (Ali, Cabinet gives the green light to cyber security policy, 2021). Policy involves securing the entire cyber-space which includes; public sector, private sector and information and communication systems (Khan A. , 2021). According to this policy, cyber-attacks against Pakistan will be considered as category 1 and category 2 attacks against Pakistan and will be countered accordingly (Ali, Cabinet gives the green light to cyber security policy, 2021). Further, *"National Telecom Security Operations Center"*, has been launched by the Pakistan Telecommunication Authority, the aim of this centre is to counter cyber threats against telecom sector and to make *"secure and resilient cyberspace for Pakistan"* (Ali, Cyber security platform for telecom sector launched, 2023).

4.3.2 Indigenization of Technological Developments and Strategic Stability in South Asia

According to a respondent, Pakistan needs indigenous developments (personal communication, October 7, 2022). According to an expert of AI, in order to make systems hacking proof, indigenous developments are necessary, Pakistan needs indigenous developments regarding both hardware and software (personal communication, October 11, 2022), because anything which is connected with internet is vulnerable and same is the case with AI based systems, there are many security issues associated with AI based systems (personal communication, October 7, 2022).

(a) Indigenization of Silicon Chips

According to a respondent, Pakistan needs long-term policies regarding semiconductor chips to enhance balance (personal communication, October 12, 2022). Non-indigenous systems incorporate threats that are not restricted to AI based systems but other non-indigenous electronic systems are also vulnerable (personal communication, October 25, 2022). Indigenization of silicon chips will help prevent security issues associated with AI based systems. Pakistan National Semiconductor Plan (PNSP) was proposed in January 2022 to exploit the country's potential in this domain, Pakistan and China have great potential for cooperation in this domain, semiconductor industry will be able to give $4 billion every year in foreign exchange (Associated Press of Pakistan, 2022).

4.3.3 Developments in Space and Strategic Stability in South Asia

According to a respondent, satellites find applications in remote sensing, which will be fully autonomous with the integration of AI (personal communication, September 29, 2022). Integration of AI in space-based systems will also aid in environment monitoring, weather monitoring and geographical information systems for military purposes (personal communication, October 12, 2022). According to a respondent, AI will find applications in space domain and possessor of such technologies will have strategic edge (personal communication, September 28, 2022). Pakistan needs developments in this domain (personal communication, October 25, 2022).

4.3.4 Pakistan-China Alliance and Stability in South Asia

According to a respondent, Pakistan-China alliance is beneficial for Pakistan because China is progressing in modern technologies (personal communication, October 25, 2022). Another respondent is of the view that, India is dependent on US technology but the imbalance which is created in South Asia due to strategic partnership between US and India will be balanced by the strategic partnership between Pakistan and China, because Chinese technology is more or less comparable to US technology (personal communication, October 7, 2022).

4.3.5 Industry-Academic Linkage to Foster Developments in AI

In order to enhance innovations in the field of AI and other new technologies, industry-academic linkage is of prime importance. For materializing developments, research in AI is necessary (personal communication, October 7, 2022). According to a respondent, such linkage is also important to cater the need for industrial problems (personal communication, October 11, 2022). According to an expert, industry academic linkage will enhance speed regarding the developments in the field of AI (personal communication, October 25, 2022).

(a) Training of Manpower in the field of AI and Cyber Security

According to a respondent, in order to foster developments in the domain of AI, training of manpower is necessary (personal communication, October 7, 2022). Advancements in the academic domain are required especially in fields like; cyber security etc. (personal communication, October 7, 2022). In order to balance regional environment research and development regarding AI, cyber security and quantum computing is also necessary.

4.4 Likely Timeframe in which AI based Systems Are Mature Enough to Tilt Strategic Balance in South Asia

AI as a technological tool will assist humans in making decisions (personal communication, October 11, 2022). AI will have assistive role, it will assist traditional systems and it will increase their efficiency and effectiveness (personal communication, October 7, 2022). With the integration of AI, speed will increase, systems will become accurate and response will be quick (personal communication, October 11, 2022). AI will not be integrated in nuclear domain, no country would take chance regarding the integration of AI in nuclear domain (personal

communication, September 28, 2022). However, both India and Pakistan are striving for autonomous systems based on AI like drones, and systems for surveying, surveillance etc. (personal communication, September 29, 2022). Still, both Pakistan and India are dependent on major states for cutting edge technologies, India is dependent on US for military systems and Pakistan & China enjoy partnership in the defence domain (personal communication, October 7, 2022).

Next, future warfare will be in cyber domain and AI driven weapons will be used (personal communication, October 25, 2022). According to a respondent, it took 15 – 20 years for AI based systems to completely replace conventional systems but all conventional systems will not become obsolete (personal communication, September 28, 2022). AI will replace, update and upgrade 50 – 80 per cent of conventional systems (personal communication, October 25, 2022).

Currently, it is unlikely that AI alone will disturb strategic balance as far as South Asia is concerned (personal communication, October 7, 2022). According to a respondent, AI will not tilt strategic balance in favour of either India or Pakistan but Pakistan needs long-term policies regarding silicon chips etc. (personal communication, October 12, 2022). AI in isolation is not able to disturb strategic stability, but it will increase the impact of existing technologies to destabilise strategically (Johnson J. , The Impact of Artificial Intelligence on Strategic Stability, Escalation and Nuclear Security, 2019). AI based systems are currently immature, maturity of AI based systems will take time (personal communication, September 29, 2022). It is true that AI is evolving but AI will take time to become secure (personal communication, September 29, 2022). According to a respondent, AI systems are 85 percent accurate (personal communication, October 25, 2022). AI based systems are vulnerable, there are chances of false alarm (personal communication, September 29, 2022). Sensors are mostly connected with Wi-Fi, there are issues regarding sensor failure, software failure etc., communication medium are also vulnerable (personal communication, September 29, 2022). Moreover, accuracy of AI based systems also gets deteriorated by adversarial attacks (personal communication, October 7, 2022). There are issues associated with AI based systems due to the malfunctioning (personal communication, September 29, 2022).

According to another expert of AI, it will take two decades for AI to become mature enough to tilt strategic balance (personal communication, October 11, 2022), because accuracy of AI based systems increases with time and for accuracy of such systems, data is required, and for efficiency and improvements, data sets should continuously increase (personal communication, October 11, 2022). Data must be real world for training of systems suited for dynamic environment (personal communication, September 29, 2022). Security issues associated with AI can only be mitigated through quantum computing, which will enhance security and makes system not vulnerable (Rugge, 2019).

Conclusion

Integration of AI by India in military platforms is concerning as far as strategic stability in South Asia is concerned. Still, it is clear from the views of experts, that AI alone is unable to undermine nuclear deterrence in South Asia. But use of AI and other technologies for nefarious purposes by India are able to impact strategic stability in South Asia. Next, India is involved in waging 5G war against Pakistan. India is involved in misinformation and disinformation campaign against Pakistan. Indian overtures do not bode well for strategic stability of South Asia. Pakistan needs developments in space, infrastructural developments, indigenization of developments regarding software and hardware, training of manpower in AI and dedicated organizations for research and development in AI and modern technologies, to balance strategic environment in South Asia. It is high times for Pakistan to take initiatives regarding the indigenization of silicon chips. Several initiatives by Pakistan like the approval of National Cyber Security Policy 2021, National Telecom Security Operations Center etc., are commendable and they will help foster stability in the region by securing cyber space of Pakistan.

Conclusion

AI has significant impact on the military domain. In the military domain, AI is able to enhance the capabilities of systems in which it is integrated. AI find numerous applications in the military domain. It is useful in logistics, surveillance, information gathering, intelligence, remote sensing and geographical information systems etc. AI has transformative effect on robots and autonomous platforms. AI find applications regarding swarming technology. AI also help in decision making. AI results in increase in efficiency, performance etc., of military platforms. AI, ML and neural networks have significant importance regarding the communication systems. With the integration of AI, systems will become more precise.

In the cyber domain, AI is helpful in governing cyber-attacks. Such systems trained on huge data are able to detect abnormalities. AI has significant importance regarding the security of cyber domain. Due to the complexity of cyber domain, traditional systems are not able to efficiently secure cyber space. Also, deep fakes, deep videos etc., are creating challenges regarding the authenticity of information. In order to detect whether any video or image etc., is manipulated or not, AI based systems are useful. Another major advantage of AI as a technological tool which has revolutionized military domain is decision making. AI based systems help in decision making. Integration of AI has solved the problem of big data.

Next, there are many issues associated with AI based systems due to their vulnerability. For the performance of AI based systems, training is very important and for training, data is necessary. Without data, performance of systems will be affected. One major issue faced by AI based systems is security. For proper functioning, systems based on AI must be secure and not prone to hacking. Military systems integrated with AI incorporates multiple sensors. Such sensors must not prone to malfunctioning. That's why, for proper functioning of AI based systems, security of all these systems is very important.

Moreover, there are many ethical issues associated with AI based systems. There is huge debate in the international arena regarding the ethical issues which are arising due to autonomous systems. There must be checks and balances associated with intelligent robots and autonomous systems. Such systems must not violate international norms. They must comply with the ethical values. Also, under any circumstances, final decision must not be delegated to machines and

autonomous systems. Without human control, there will be huge consequences for security and stability. From the views of experts, it is clear that final decision making regarding autonomous systems must remain at the disposal of humans.

In the context of South Asia, India is integrating AI in various military platforms at an increasing rate. India is integrating AI in drones and various autonomous systems. India is also inducting advanced weapons from different countries. It is spending billions of dollars in acquiring various weapons from many different countries like; US, Russia etc. India is modernizing its navy and is also increasing naval assets of strategic significance in the Indian ocean region. Such overtures will create imbalance in the region.

Considering Indian nefarious designs, integration of AI by India in various military platforms will not bode well for strategic stability of South Asia, because India has conducted many violations of Pakistan's maritime boundary and is also active in 5G war and hybrid war against Pakistan. India is making propaganda against Pakistan. It is involved in misinformation and disinformation campaign against Pakistan. Considering Indian endeavours, advancements regarding AI etc., by India have the potential to disturb strategic stability in South Asia. However, the impact of militarization of AI on strategic stability in context of South Asia will only be significant if AI based systems became mature to great extent. In context of South Asia, AI based systems will take time to become mature.

From the views of experts, it is clear that Pakistan is closely following Indian developments and is also striving to balance regional strategic environment. However, India advancements are due to its alliances, bigger market, strides in IT industry etc. Pakistan needs policies regarding the indigenization of silicon chips etc., which will also offer huge benefits for Pakistan.

From the views of experts and thorough analysis of books, journals and expert opinions, it is concluded that AI as a technological tool is able to increase conventional asymmetry between Pakistan and India. Integration of AI in military domain by India and advancements in this domain etc., will not bode well for strategic stability in South Asia.

It is high times for Pakistan to undergo infrastructural reforms. There must be indigenous developments. Indigenous manufacturing of semiconductor chips is very important, because it

will enhance efficiency of systems and will enhance security. There is an exigent need for dedicated organizations which will foster research and development regarding AI and other latest technologies. There is a need for separate organizations for mitigating issues in cyber domain, and to foster security in the cyber domain. Further, training of manpower in the domain of AI is very important for advancements in AI related industry.

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