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Technological Innovations In Border Surveillance: A look into India's China strategy

- **Ms. Komal* and Dr. Shreesh Kumar Pathak****
Research Assistant, Amity university, Noida*
Assistant Professor, Amity University, Noida**

Amity Institute of International Studies
Amity University Uttar Pradesh, Noida, UP

Abstract

Border surveillance plays a crucial role in ensuring national security and the territorial integrity of a nation, especially in regions marked by geopolitical tensions. Border security has become a leading concern,particularly for India amid its intricate relations with China. This paper examines India's multifaceted approach to border surveillance through technological innovations, with a look into its complex relationship with China. It also explores the critical role played by the advanced technologies such as Artificial Intelligence, satellite imaging, Unmanned Aerial Vehicles and sensors, in strengthening India's capability to monitor and secure its borders effectively. Additionally, it looks into the contributions of these innovations in intelligence gathering enhanced situational awareness and the response mechanism along the India-China border. The research also discusses the geopolitical aspects of India's border surveillance technological advancements, emphasizing the complex interactions that exist between security issues, diplomatic ties, and regional stability. A thorough examination of India's China strategy in Border surveillance contributes to this research an enhanced awareness of the evolving nature of modern security threats and how technology impacts strategic responses.

Keywords: India-China, border surveillance, technological advancements, India's China strategy,

Introduction

Border security has become a leading concern for nations, particularly in regions with geopolitical tensions and territorial disputes like India and China. The integration of technology and geopolitics has been a breakthrough in the constantly evolving nature of international relations. Global militaries are starting to incorporate Artificial Intelligence(AI) into their combat systems. Artificial Intelligence is being utilized in training, robotics, autonomous combat vehicles, cyber security, logistics, surveillance, and Unmanned Aerial Vehicles (UAVs). The safety of the borders from any type of infiltration and attack can only be secured by the integration of technological advancements and an informed action by the government, economic agencies and other related stakeholders of the nation. This article explores the technological innovations in border surveillance technology and looks into India's strategic approach in countering and securing its border from China's threats. The Line of Actual Control (LAC) has been a focal point for territorial disputes, leading to heavy investments in border surveillance technologies by India and

China. The strategic importance of this border region amplifies the significance of technological advancements in maintaining security and territorial integrity.

Technological innovations in border surveillance

Technological advancements play an integral role in redefining border security and surveillance strategies. The tense historical past, vast and rugged terrain and complex geopolitical situations are some of the challenges that can be tackled by the development of these technological innovations.

The traditional approach of technology to border management refers to the implementation of high-tech weaponry, such as combat vehicles, small arms ammunition, and advanced communication technologies. There are several significant technological innovations:

- Technologies assisted by Artificial Intelligence based solutions, sensors, integration of cameras have helped in the upgradation of the border surveillance. High-resolution satellites integrated with the Advanced Geographic Information System (GIS) monitor troop movements, collect information in real time and also evaluate topographical changes along the Line of Actual Control (LAC). For instance, the AI predictive analytics used by Indian Comprehensive Integrated Border Management System (CIBMS) enables proactive reactions to possible threats by identifying and adjusting to invasion patterns.
- The identification of border breaches, categorisation of targets and the improvisation of the defense operations have been achieved with the help of these technological innovations. Integrated sensor technologies help build a multi-layered surveillance system. The use of motion sensors, infrared cameras, and seismic detectors add a little extra layer of protection. These systems have been strategically placed near the border region to identify any unusual activity and it notifies the concerned authorities. The Indian government's Integrated Border Management System (IBMS), which has a network of sensors for real time monitoring, serves as an example.
- Another flexible and affordable solution to border surveillance is the application of drones or Unmanned Aerial Vehicles (UAVs). UAVs aid in the comprehensive surveillance and monitoring of the difficult terrains that cannot be monitored by humans, with cutting-edge sensors these vehicles provide real time surveillance which aids with the quick action in the case of border incursions. The Indian Army , for instance, uses the Skylark UAV for short range aerial surveillance, which gives them real-time Intelligence on events along the border and any threats.
- The large scale data processing and utilization by the Artificial Intelligence and Machine learning help with the informed and insightful decision making, which improve the capacity to proactively address possible threats near the border region. Pattern recognition and predictive analysis by these technologies aid in the identification of potential dangers and irregularities, which in turn helps with the preventive measures.
- Certain border locations have implemented smart fences, which integrate surveillance technologies like cameras and sensors. This technology stops unauthorized border crossings and helps secure particular areas. Strategic border infrastructure development also improves overall border management by constructing roadways and surveillance posts. Radar equipment positioned on the ground are essential for tracking aviation and ground movements near the border. For example, the satellites of India's Cartosat series provide precise images that help with tracking infrastructure development, troop movement, and transformation.

Historical context

The Himalayas have served as China and India's boundary for ages. In the late 19th and early 20th centuries British India and the Qing dynasty established treaties and accords to define their borders. China rejected and refused to sign the 1914 Simla Accord's proposal to draw the McMahon line (red line) as the demarcation between Tibet and

British India.[1] The origins of the territorial disputes between the both countries can be traced back to World War II, just after the independence of these countries.
An array of diplomatic meetings aimed at resolving boundary disputes took place in the early 1950s; these included the well- known Panchsheel agreement of 1954. But in the early 1960s, hostilities increased and resulted in the Sino-Indian War of 1962, which intensified territorial disputes and paved the way for the unresolved de facto border known as the Line of Actual Control (LAC).
The primary reasons for the outbreak of the 1962 Sino-Indian war were disagreements over how the McMahon line was perceived and interpreted on the ground, as well as China's military claim to Aksai Chin region of Ladakh.[2]
Agreements like the 1993 Agreement on the Maintenance of Peace and Tranquility along the LAC testify to attempts at harmonization made in the late 20th century.[3] The 2017 Doklam standoff and the Galwan Valley clash in 2020 serve as an example of how border issues continue to exist, which highlight the ongoing difficulties in India- China relations.

Current Border security Landscape

The India-China border that stretches over thousands Kilometers is one of the world's most disputed and strategically significant borders. The rugged terrains and the diverse climates present a challenging environment for effective surveillance.

The increased militarisation and border surveillance, due to the 2020 Galwan Valley clash have influenced the current border security landscape. There has been a great improvement in the infrastructural development along the borders, to improve mobility and logistical support for better patrolling and border monitoring.
The conventional approach towards border security has proven to be inadequate, leading both countries to invest heavily in advanced and innovative technologies for border surveillance and security. Both the countries are integrating technological innovations and the defense sector due to historical mistrust and strategic competition. The technological advancements like satellite imagery, radar systems and UAVs, have paved the way for enhanced border surveillance capabilities.

Both the countries have integrated surveillance technologies and other advanced technologies like drones, UAVs , and satellite imagery to monitor the border and for the detection of any intrusions or suspicious activities.
Overall, both China and India maintain a high level of alertness and preparedness, and the border security landscape along their shared boundary is still delicate and complicated. While diplomatic attempts are being made to reduce tensions, the situation is still unstable and there is a constant need for strong border management and security preparedness.

Cybersecurity challenges

The India-China border faces a new set of cybersecurity concerns in a time when technology is essential to border security. This section explores the cybersecurity issues that are common in the border security dynamics between China and India, emphasizing data protection issues, communication system shortcomings, and the potential threat of counterintelligence.

- Vulnerabilities in communication systems

[1] Singh, G. J. J. (2019). *The McMahon line: A Century of Discord*. Harper Collins.

[2] Joshi, M. (2022). *Understanding the India-China border: The Enduring Threat of War in High Himalaya*. Oxford University Press.

[3] Joshi, M. (2022). *Understanding the India-China border: The Enduring Threat of War in High Himalaya*. Oxford University Press.

The core of border security efforts consists of communication technologies, which enable intelligence exchange, coordination, and strategic planning. These systems are vulnerable to cyberattacks, though. Reports surfaced in 2020 of Chinese hackers targeting defense-related companies and governmental organizations in India. These assaults attempted to take advantage of vulnerabilities in communication networks, possibly compromising private data about activity along borders. The necessity of strong cybersecurity measures to secure communication lines was highlighted by this occurrence.

- Data protection concerns

Significant amounts of data are produced by the widespread use of surveillance technology, such as satellites and sensor networks, which are essential to border security. It is critical that this data be protected against modifications and unwanted access. The data encryption and storage are an integral part of the data protection. The worldwide cyberattack known as "WannaCry" in 2017 had considerable impact on businesses all across the world. Although it did not specifically address border security, it did illustrate the potential scope and severity of ransomware assaults. Similar attacks could compromise the accuracy of information about army movements, infrastructure, and surveillance in the context of the India-China border, underscoring the urgent need for strong data protection measures.

- Counterintelligence threats

Threats from counterintelligence are possible because of the border's digital systems' interconnectedness. The issue of state-sponsored cyber spying is quite serious. APT30, a Chinese hacker gang, was exposed in 2015 for carrying out cyberespionage activities against Indian security and military institutions. In an attempt to obtain sensitive information without authorization, the gang attacked communication systems. This case highlights the ongoing threat posed by state-sponsored entities using cyberspace to get intelligence and highlights the necessity of ongoing surveillance and counterintelligence measures.

- Cross- border cyber attacks

Cyberspace is a site of geopolitical friction between China and India, which increases the risk of cross-border cyberattacks. 2020 saw an upsurge in cyberattacks from China, according to Indian organizations, amid increased border tensions. Phishing scams and more complex operations aimed at vital infrastructure were among the attacks. These kinds of events draw attention to the possibility of state-sponsored cyberwarfare strategies that could compromise the operation of border security systems while also interfering with digital infrastructure.

- Addressing cybersecurity challenges

China and India need to fund joint cybersecurity projects in order to overcome these obstacles. Defenses can be strengthened by establishing lines of communication for exchanging threat intelligence, organizing cooperative cybersecurity exercises, and implementing global best practices. Additionally, maintaining the endurance of digital

infrastructure along the India-China border depends on funding research and development to keep ahead of changing cyber threats.

The evolving dynamics of border security in the India-China context demand heightened attention to cybersecurity. Vulnerabilities in communication systems, data protection concerns, and counterintelligence threats underscore the intricate nature of the digital landscape along the border. Learning from past incidents and adopting proactive, collaborative cybersecurity measures will be pivotal in safeguarding the integrity of border security operations and ensuring stability in the region.

India's strategy and Investments:

" *Embracing the latest advancements in warfare technology should be a marathon rather than a sprint for the Indian army***"**[4]

Following independence, India's post independence policy for technological development was initially focused on self-sufficiency, but it eventually changed to place greater emphasis on self -reliance. It has been properly understood that achieving self-sufficiency in the modern world is nearly unachievable, as it would be extremely costly and time consuming and could perhaps undermine our strategic goal.

In June 2018, India announced its first national AI policy, along with the introduction of defense- focused proposals by a government appointed AI task committee. Among these proposals were the establishment of a Defense AI Project Agency and a high level AI Council, both of which went into effect in 2019.[5]
During the Dakshin Shakti military exercise in 2021, the Indian army showcased a group of seventy-five AI enabled aerial drones and used AI for intelligence, surveillance, and research.[6] The government is also involved in the research of imagery analysis, drone collision avoidance, prediction of the atmospheric visibility and ship tracking.
Regardless of any general doubts the government may have about the safety of AI, it is moving forward to discover potential military uses for the technology in order to maintain its competitiveness in the global market, particularly as part of the sharpening strategic competition between Beijing and Delhi. China's AI sector is very competitive globally, with a modest portion of its defense budget, the country might develop new military uses for this technology.
Drones, command and control center's, marine border security, and advanced surveillance systems are a few of the strategies implemented by the Indian government. Particular attention has been paid to technology infields including command and control, information and communication, the Air Defence, Control and reporting systems, and the battlefield management system. Significant advancements like the radio local system and radio trunk system have greatly enhanced military communication along the border.
One of the newest technological developments in border security surveillance worldwide is the use of drones for security and surveillance. India is working rapidly to build its own fleet of drones that can be used for both aerial and ground purposes. The government is also identifying the need for modern UAVs that can be easily incorporated with weapons systems and have a target range of up to 10 kms.

[4] *Indian Army's year of technological advancement in 2024*. (n.d.). orfonline.org. https://www.orfonline.org/expert-speak/indian-army-s-year-of-technological-advancement-in-2024
[5] *Early steps in India's use of AI for defence*. (n.d.). IISS. https://www.iiss.org/online-analysis/online-analysis/2024/01/early-steps-in-indias-use-of-ai-for-defence/
[6] *Early steps in India's use of AI for defence*. (n.d.). IISS. https://www.iiss.org/online-analysis/online-analysis/2024/01/early-steps-in-indias-use-of-ai-for-defence/

In May 2022, US president Joe Biden and Prime Minister Narendra Modi announced a bilateral cooperation in Artificial Intelligence through the US- India partnership on critical and emerging technologies.[7] The program was first introduced at the national security adviser level.
In addition, India's Defense Research and Development Organisation (DRDO) and its Israeli counterpart negotiated a deal in 2021 to develop AI related technologies, and it may explore working with France, Italy, and the UK. [8]
In terms of diplomacy, India has stated that it is in favor of transparency, safety, trust, and responsibility when it comes to AI, mirroring the positions of many of its long standing allies, including China and Russia.

On the 76th Army Day, the Chief of Army Staff, General Manoj Pande, declared 2024 to be the year of 'Technology Absorption' by the Indian Army.[9] The Indian Army's technology initiatives include a noteworthy venture into cyberspace. The focal point of this effort is Project SAMBHAV, which presents an end to end secure mobile environment running on modern 5G technology. The project is presented as a significant advancement in strengthening India's military power. General Pande also addressed the connectivity challenges and laid emphasis on the infrastructural development, 4G connectivity for Army posts along the border. He also talked about the work related to underground storage. He further stated that there is progress in all domains in the infrastructure along the Line of Actual Control.
The Military Objects Detection System in satellite images is another significant innovation. This Artificial Intelligence System makes it possible to automatically identify and categorize military weapons in real time from satellite photos. By improving information,surveillance, and reconnaissance, the integrated AI module enables commanders at all levels to make timely decisions.
As part of the Army's emergency provisions, General Pande emphasized the introduction of superior vehicles, drones, and counter-drone equipment. The reorganization of the artillery units and the decrease in the use of animals in transport units demonstrate the Army's dedication to modernisation and flexibility in the rapidly evolving conflict environment.
Staying up to date with the rapidly evolving field of military technology is a continuous task of military technology is a continuous task that requires a sustained dedication. The Indian Army's transition in 2024 to technology absorption presents opportunities as well as concerns. Although the focus on incorporating cutting-edge technologies like cyber security and drones shows a proactive reaction to changing difficulties, the shift from a more comprehensive transformational goal needs careful thought.
The requirement for rapid technological adaptation is highlighted by the urgency brought by global military trends and the proximity of China's developing capabilities. It's also important to recognise the long term commitments and the underlying challenges of technology integration.

Challenges and limitations:

The border between India and China, which is marked by difficult terrain and complex geopolitics, has seen a notable increase in technological advancements intended to strengthen security protocols. The causes of threat to its disruption and destruction are likewise growing as a result of these advancements. Law enforcement, security, and defense organizations are facing difficulties as a result of new vulnerabilities brought about by automation technologies, analytical, and communication devices.
The potential for privacy violations is one of the main obstacles. The widespread application of surveillance technologies, such as drones, biometric systems, and satellite imaging, involves the ongoing observation of people in border areas. This has raised questions about how to strike a balance between the essential right to privacy and

[7] *Early steps in India's use of AI for defence*. (n.d.). IISS. https://www.iiss.org/online-analysis/online-analysis/2024/01/early-steps-in-indias-use-of-ai-for-defence/

[8] *Early steps in India's use of AI for defence*. (n.d.). IISS. https://www.iiss.org/online-analysis/online-analysis/2024/01/early-steps-in-indias-use-of-ai-for-defence/

[9] *Indian Army's year of technological advancement in 2024*. (n.d.-b). orfonline.org. https://www.orfonline.org/expert-speak/indian-army-s-year-of-technological-advancement-in-2024

national security requirements. It becomes essential to find the correct balance in order to guarantee that the use of these technologies is in line with ethical principles and upholds the rights of individuals.

Furthermore, the concerns posed by technical dependency still exist in the context of border security between China and India. Cybersecurity issues are brought up by an increased reliance on digital communication and data management systems. Sensitive data could be compromised by a breach in these systems, which might have an effect on national security. Another concern is the misuse or the abuse of advanced technologies. Moreover, the rugged terrain and complex climate conditions further act as an operational challenge for the deployment and maintenance of the surveillance equipment.

The ethical consequences of technological advancements extend to their effects on local communities living in border zones. These communities may experience disruptions to their daily routines and customs as a result of the implementation of monitoring measures. It is a difficult ethical issue that requires attention to strike a balance between the needs of national security and the rights and welfare of local residents. Furthermore, the setting of border security technologies raises questions about accountability and transparency.

While these modern advancements are important in the development of border security surveillance, they also carry with them the challenges and ethical threats. There is a need for careful consideration for the balance of the requirements of national security with keeping in mind the individual privacy and appropriate use of modern technology.

Seeking solutions:

The integration of technological innovations in border surveillance has posed some challenges. These challenges need to be addressed with a comprehensive approach that integrates technological, ethical, and diplomatic approaches , only then the effective and responsible use of these advancements can be ensured.

The creation of strong ethical and regulatory frameworks controlling the application of border security technologies is one important way to address this issue. The acceptable boundaries for data collection, unmanned system use, and surveillance should be clearly defined. These frameworks must include ethical criteria in the use of technology, protect against misuse, and respect individual privacy. Ensuring accountability and cultivating public trust are promoted by transparency in the development of these frameworks.
It is crucial to use technological solutions to improve cybersecurity. Digital systems can be strengthened against possible threats by implementing best practices, conducting frequent audits, and investing continuously in cybersecurity infrastructure. Cooperation in cybersecurity measures between China and India, encompassing information exchange and cooperative projects, may reduce threats and advance border stability.

Another crucial approach is to take the initiative in promoting global cooperation. Misunderstandings and unintentional escalation can be avoided by establishing diplomatic channels for communication and collaboration on technology advancements. Dialogue platforms between China and India could encourage common norms and minimize the possibility of disputes resulting from technical breakthroughs by facilitating conversations about responsible technology use.

A multifaceted approach is required to tackle the challenges posed by technological advancements in border security surveillance. A complete solution must include legal and ethical frameworks, cyber security precautions, international collaborations, and ongoing technological advancements aimed at reducing negative outcomes. With the help of these solutions the nations can invest in technological developments while lowering risks and fostering border security.

Conclusion:

Technological advancements have transformed border security surveillance, allowing countries like India to take preventive measures to protect their borders. India's deliberate efforts to use advanced surveillance technologies demonstrate its commitment towards safeguarding its borders and upholding peace and stability along the border with China.

The integration of new technologies offers chances to improve security and situational awareness as both countries work to protect their borders and express their interests. Although innovation seems promising, concerns remain over its wider effects on Human Rights, regional stability, and the possibility of escalation. In order to shape the future of border surveillance technology, it is more important than ever to promote communication, openness, and international cooperation as we negotiate this terrain.

As the geopolitical landscape evolves, the effective utilization of technological innovations will remain central to India's border security strategy vis-a-vis China, but the growing capabilities of China's technological developments will keep India on her toes.

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