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DRONE SURVEILLANCE SYSTEMS ALONG INDIA'S COASTLINE

Manjiri Abhay Phansalkar

Edited by: Abhinav Govind Patole

About the Author

Manjiri Abhay Phansalkar is an under student at the Jindal School of International Affairs and is a Research Assistant at the Pankaj Kumar Jha Centre for Security Studies, JSIA.

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Abstract

This paper investigates the at hand surveillance systems of India and reproduces evidence of the legitimacy and prowess of the progressive handling of drones in maritime security along her coastline. In order to realise this pursuit, the paper will explore many aspects like analysing the surveillance system and its components constructively, namely the requirement of drones, their uses, and strengths and weaknesses of drone usage. The reverberation of this systematic analysis primarily highlights the dual implications of technological advancement and the integration of artificial intelligence into the realm of security alongside the promulgation of large-scale exercising of this buildout in the sphere of national security, specific to maritime affairs. From the standpoint of innovative progress, the paper presents certain potential applications and detrimental curtailments that must be refined to thoroughly exercise and unrealized the capacity of this technical buildout.

Keywords

Drones, India, Coast, Maritime Security, Surveillance

Introduction

Given the 21st century scenario and its continuous technological advancements across the globe, there is an equal quantum of unforeseen circumstances that determine, certify, and help reason the usage of such cutting-edgemachinery, that is constantly evolving. Due to advances in research and development mechanisms, these technologies are available in the major spheres of human, economic as well as security realms today. A notable advancement in drone technology, often connoted as unmanned technology, is its significance in all spheres of employment Drones are extensively being used for activities of human and common importance such as monitoring agriculture, healthcare, etc. Drones have also grown increasingly important in the realm of security and surveillance systems. The Indian Army first acquired drones from Israel for reconnaissance and surveillance purposes during the Kargil War of 1999 with Pakistan.

India's the dual strategy for its drone program consists of predominantly two aspects firstly, purchasing drones equipped with the latest technology (predominantly from Israel) and secondly, developing indigenous UAV technology through R&D progress by DRDO (Defense and Research Development Organization) along with a few private companies and start-ups. In recent times, the use of drones and UAVs have been largely for ISR Missions[1], that include the targeting of civilians or enemy assets for intelligence, surveillance, and reconnaissance purposes. Given the importance of availability and know-how of drone applications, it is necessary for India to revamp up its research, development, and technical prowess to be adept with the mechanisms of national security.

Analysing Drone Surveillance Systems in India

While acknowledging the tumultuous outline of ongoing conflicts in the Asian continent and recognising the possibilities of unprecedented expansion of the dispute (considering the westward extension of the Israel-Hamas contention) the other states must be vigilant so as to curb the occurrence of any unforeseen eventuality. Although military preparedness is essential for achieving the goals of supervision, protection, and belligerence, it is the ability to observe and monitor that gives the armed forces a moral reason as well as a cognizant footing to undertake armed operations. In the indigenous context of coastal surveillance, significant challenge is the large expanse of India's coastline. According to academic sources, India's total coastline measures approximately 7516.6 km, wherein 6,100 km is the coastal expanse of the mainland complimented by 1,197 km of coastline possessed by Indian islands of Lakshadweep in the Arabian Sea, Andaman and Nicobar Islands in the Bay of Bengal, and Indian Ocean. Factors such as strategic location help India position itself as a hub for economics and global recognition. However, the great expanse of the peninsula also exhibits dangers of trespassing and infringement of precarious individuals into the sovereign territory A recent occurrence that can serve as an example for the need to improve maritime security would be the tragic events of November 26, 2008, when

[1] Maniyar, J. (2024, August 11). *The history of drone adoption for military reasons in India*. raksha-anirveda.com. https://raksha-anirveda.com/the-history-of-drone-adoption-for-military-reasons-in-india/

Lashkar-e-Taiba terrorists wreaked havoc in Mumbai, claiming 166 lives.[2] Another recent infringement was by the trio - Nitso Ditto (31), Vijay Vinay Anthony (29) and J Sahayatta Anish (29) – who navigated Indian waters after absconding with a boat from their employer in Kuwait and reached the Gateway of India. These events underscore the urgent need to regulate maritime movement in Indian waters[3]. Retaining the plight of such unforeseen cases, this section aims to deal with the three aspects of requirement, practice, and implications of administering drones in the maritime security and surveillance sphere of India.

Aims and Objectives

As an introductory effort, the Indian security agencies have pressed the requirement of advanced surveillance systems along the coastal waters while also mapping out the implementation in areas that are deemed to be more vulnerable to attacks and transgressions accordingly being better equipped with retaliatory technology[4]. Following are five central considerations that guide the employment of drones in surveillance systems along India's coastline.

- The first consideration is equipping drones with high-resolution cameras and sensors that would revolutionise the efficiency and cost-effectiveness of coastal surveillance[5] . Cameras with high-resolution characteristics allow for the achievement of dual tasks of clear and high-quality image procurement alongside 4K resolution video quality. Through these, the operators can obtain dependable sources of information that produce the competent conditions for immediate reaction. The appropriate usage of relevant sensors allows for the operators to exercise precise positioning of the drone, stable navigation as well as automated functions that affirm the safety of the drone.
- The second consideration, is recognising the need for heightened vigilance, is the deployment of long-range drones to monitor the 652.6-kilometre coastline in Maharashtra

[2] Pti. (2024, March 3). Drones likely to be pressed into maritime surveillance, say officials. *The Economic Times*. https://economictimes.indiatimes.com/news/defence/drones-likely-to-be-pressed-into-maritime-surveillance-say-officials/articleshow/108186055.cms?from=mdr
[3]Ibid.
[4] Ibid.
[5] Ibid.

and the 101.0-kilometre stretch in Goa[6]. Long range drones are characterised by the dual prowess of increased battery life as well as ability to travel large distances, generally spanning from a 5-kilometre range[7] to 15-kilometres. In addition to this, the unmanned aerial vehicles also possess the attribute of reduced loss of connection[8] while covering ample distances. In the sphere of the coastline in Maharashtra, the requirement of long-range drones stems from the factors of proximity to the neighbouring state of Pakistan as well as historical occurrences of territorial infringement through the waters. As for Goa, it is necessary to adopt such measures to avoid illegal import[9] of substances such as drugs.

- The third consideration depicts the Coast Guard's procurement of drones with advanced capabilities, including vertical take-off and landing features, signifying a step towards enhancing surveillance, security operations and search-and-rescue missions[10]. Complementing these efforts, is the Indian Navy as seen in the recent search-and-rescue missions carried out in the Red Sea. Although the surveillance systems used were primarily manual, in terms of patrol aircrafts being deployed to affirm the need for rescue, on procuring UAVs equipped with VTOL[11] technology, which can take off, hover as well as land in any given terrain, without the requirement of runways allowing for a better and precise knowledge of the area under surveillance.
- The fourth consideration is drones equipped with sophisticated identification and tracking capabilities that can identify vessels with Automatic Identification System (AIS) and track their movements. An (AIS) is an automated tracking system that displays the presence of other vessels in the drone's vicinity[12]. The possession of such technology offers dual benefits for drone surveillance systems. Firstly, identification of unidentified vessels: Drones can identify and track unidentified or uninformed vessels in national waters,

[6] Pti. (2024, March 3). Drones likely to be pressed into maritime surveillance, say officials. *The Economic Times*. https://economictimes.indiatimes.com/news/defence/drones-likely-to-be-pressed-into-maritime-surveillance-say-officials/articleshow/108186055.cms?from=mdr
[7] Ibid.
[8] Ibid.
[9] Ibid.
[10] Ibid.
[11] Ciobanu, E. (2022, July 27). What is a VTOL Drone & How do VTOL Drones Work? - Droneblog. *Droneblog*. https://www.droneblog.com/vtol-drones/
[12] Marine Insight. (n.d.). *Shilavadra Bhattacharjee*. https://www.marineinsight.com/author/shilavadra-bhattacharjee/page/2/

enabling preventive measures to be taken[13]. Secondly assistance to indigenous vessels: Drones can assist indigenous vessels in distress by using AIS and tracking systems to facilitate communication and coordinate rescue efforts.

- The fifth consideration is the integration[14] of maritime stakeholders into a unified coastal security framework, supported by the establishment of Joint Operations Centres (JOC) in key coastal cities. The JOCs of the Navy and Coastal Security Operations Centres of the Indian Coast Guard area maritime security companies that were established at the operational level of overall maritime activities[15]. Some notable coastal cities where JOCs have been deemed to be established are Mumbai, Kochi, Visakhapatnam, and Port Blair. Alongside these, other centres such as National Committee on Strengthening Maritime and Coastal Security (NCSMCS) at the apex level have also been established with Cabinet Secretary at the helm to review important matters pertaining to Coastal Security, effective centre-state coordination and committees have also been established at State and District level[16]. The formation of such centres was noticed post the catastrophic event of 26/11, whereby the intentional targets of terrorist outfits were understood to be inland as well[17].

Ongoing Drone Programs

Having closely examined the pre-requisites necessary for employing drones in the surveillance system along India's coastline, it is imperative to note that the nodal point of requirement implying the induction of drones as an integral aspect of surveillance stemmed from the 26/11 Lashkar-e-Taiba attack on the Taj hotel, in Mumbai. However, on manually tracking the history of procurement of drones, it would emerge that the first-ever use of drones in the sphere of warfare was exercised in 1999, during the Kargil War with Pakistan. As redundant as it may seem, both

[13] Ibid
[14] ibid
[15] *Indian Navy coordinates largest ever coastal defence exercise ten years after "26/11."* (n.d.). https://pib.gov.in/pressreleaseshare.aspx?prid=1560995
[16] *Indian Navy coordinates largest ever coastal defence exercise ten years after "26/11."* (n.d.). https://pib.gov.in/pressreleaseshare.aspx?prid=1560995
[17] *Indian Navy coordinates largest ever coastal defence exercise ten years after "26/11."* (n.d.). https://pib.gov.in/pressreleaseshare.aspx?prid=1560995

the mentioned instances characterise the dual nature of a legitimate army as well as a terrorist non-state actor fielded by the neighbouring state of Pakistan. This section aims to understand the foregrounds for procurement of drones as well as gauge the strong reasons behind drones being employed in the field of maritime surveillance by the Indian Armed forces.

As previously stated, the magnanimous extent of the peninsula causes both advantages in terms of economic prowess, as well as disadvantages in terms of disregarding territorial integrity. It is in response to the latter, that the legitimate procurement of drones arrives on six[18] prime foregrounds. First, drones can be used to enhance surveillance of movements in and around the Indian subcontinent while also monitoring rival armies, gathering intelligence, and preparing for potential crises. Second, is the attribute of reconnaissance that allows the military to comprehend the enemy's territory and geographical topography further allowing them to frame and practise their operations/missions robustly. Third, is the context of targeted strikes, whereby the drones can be equipped with missiles and programmed to destroy specified locations accordingly. This usage is significant, as the deployment of target-specific UAVs can be used in alternative instances, where the deployment of armies could prove to be dangerous. Fourth, is the character of search and rescue, wherein UAVs empowered with tracking and communication specific technologies allows the operator to locate and salvage a known entity. Lastly, is the aspect of communication and coordination that allows for the operating entity to contact other entities and gain relevant inputs/intelligence.

While most procured drones are for the Indian Army, the IAI-HAL NRUAV (Naval Rotary Unmanned Aerial Vehicle) is for the Indian Navy, and is for Coastal surveillance. It is a rotorcraft that is being co-developed by a unit of IAI[19] (Israel Aerospace Industries) of Israel the Malat Solutions, and HAL (Hindustan Aeronautics Limited) of India for the Indian Navy. Two main characteristics of this surveillance model are firstly, the capability to undertake operations and carry out advanced intelligence recces, surveillance, and reconnaissance (ISR[20]) missions from

[18] *Indian Navy coordinates largest ever coastal defence exercise ten years after "26/11."* (n.d.). https://pib.gov.in/pressreleaseshare.aspx?prid=1560995
[19] Pike, J. (n.d.-d). *IAI-HAL NRUAV UAV*. https://www.globalsecurity.org/military/world/india/nruav.htm
[20] *Intelligence, surveillance, and Reconnaissance: Establishing guidance, timelines, and accountability for integrating intelligence data would improve information sharing*. (n.d.). U.S. GAO. https://www.gao.gov/products/gao-10-

warship decks and secondly, it employs the vertical Take-off and Landing (VTOL) technology that enables ideal operation of the UAV regardless of the nature of terrain during take-off and landing. Along with the IAI-HAL NRUAV[21], many SUAVs i.e. small unmanned aerial vehicles, UCAV i.e. Unmanned Combat Aerial Vehicles and MAVs i.e. Micro Air Vehicles have been manufactured by indigenous institutions such as DRDO and HAL and even private enterprises such as that of Adani Group have proving their utility in the domain of surveillance and military action. Some of these include the Trinetra UAV (enabled with remote monitoring from a ground station), DRDO Rustom and TAPAS-BH-201[22] (can run for up to 24 hours and conduct real-time surveillance of enemy engagements), developed by DRDO; Adani Hermes 900 co-developed by Adani Aerospace and Defence, a subsidiary of Adani Group and Israel's Elbit systems (equipped with missiles employed for combat operations) and HAL CATS (Combat Air Teaming Systems) (works in tandem with manned aerial vehicles) developed by HAL. These are the prominent drone surveillance systems that have been employed along the coastline of India and are being operated by the security agencies.

Examining Pro et Contra

Observing the timeline of drones procured by India, it can be accepted that the earliest as well as the lion's share of UAVs were obtained from Israel, followed by the United States of America. Following the conflicts at Doklam and Galwan valley, India procured the Heron[23] and RQ-11 Ravens[24] from Israel and the United States, respectively. While recognizing the need to acquire state-of-the-art drones for the armed forces, it's important to acknowledge the challenge of achieving self-reliance *atmanirbharta*[25] (self-reliance) in this domain. High-end UAVs and their

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[21] Pike, J. (n.d.-d). *IAI-HAL NRUAV UAV*. https://www.globalsecurity.org/military/world/india/nruav.htm

[22] *TAPAS-BH | Defence Research and Development Organisation - DRDO, Ministry of Defence, Government of India*. (n.d.). https://www.drdo.gov.in/drdo/tapas-bh

[23] Felstead, P. (2024, February 1). Unmanned aerial dominance: the Heron UAV family's crucial impact on the 2023 'Iron Swords' War -. *European Security & Defence*. https://euro-sd.com/2024/02/sponsored-content/36269/heron-uav-impact-iron-swords/

[24] *RQ-11 Raven Unmanned Aerial Vehicle, United States of America*. (2023, August 9). Army Technology. https://www.army-technology.com/projects/rq-11-raven/

[25] Maniyar, J. (2024, August 11). *The history of drone adoption for military reasons in India*. raksha-anirveda.com. https://raksha-anirveda.com/the-history-of-drone-adoption-for-military-reasons-in-india/

components are often sourced from partner nations, which can limit India's technological independence. Nevertheless, Indian research centres such as DRDO and HAL are attempting to develop indigenous technologies in the field of UAVs. This section actively deals with encountering the major benefits and challenges experienced during employing drones for coastal surveillance.

Benefits

1. Efficiency in terms of duration - In accordance with the recent technological developments in UAV operations, it has become clear that drones can be operated for longer durations while succeeding in the dual goals of real-time live surveillance along with reduced consumption of battery while also spanning greater distances. This efficiency[26] is supported by the nature of motors and propellers employed in the development of the drone.
2. Efficiency in comparison with Human Surveillance - In contrast with the surveillance mechanisms adopted by military personnels, drones can individually cover large expanses of sea/ocean coverage. This implies the requirement of deploying fewer military personnel for manual surveillance in a particular range on being substituted by UAVs. Further, this attribute reduces the costs in the long run.
3. Enhanced surveillance Capacity - In comparison with traditional aspects of surveillance, such as the usage of cameras and human patrols, the usage of drones allows for the operators to exercise their surveillance even in remote areas. Complimenting this, is the availability[27] of high-quality image capturing technology that provides increased accuracy and precise details of the area under supervision.
4. Cost Effectiveness - As the cost of deploying military patrols and traditional mechanisms can be understood to be fiscally as well as emotional challenging, the case with UAVs starkly differs, given the attribute of being operated by on-ground machinery.

[26] Onaola, S. (2022, December 28). *The Top 10 Benefits and uses of drones in 2023*. Dronescend. https://dronescend.com/blogs/news/the-top-10-benefits-and-uses-of-drones-in-2023
[27] Ibid

5. Improved Safety - Often, drones can be used in areas of high-risk quotient, wherein the employment of military patrols can prove to be fatal. In a scenario of potential tsunami, the usage of drones to check the presence of individuals trapped in and near the ocean and then perform rescue operations is better suited than the presence of human patrol groups who may face a similar threat.
6. Rapid Response Times - Equipped with enhanced technology and high-end cameras and sensors, such machinery can be put to task with immediate effect in situations of emergency and allow for rapid evacuation of individuals in the vast expanse of sea/oceans.

Challenges

1. Technical Limitations - Although drones prove to be excellent instruments of monitoring and supervision, their efficiency is often interrupted by certain technical limitations such as that of weather conditions. In the exceptional circumstances of coastal areas, it is natural for regular downpours to occur. It is due to such interferences[28] that flying inefficiency, and disruptions in signal can disrupt their communication systems, causing further hindrances in surveillance mechanisms.
2. Legal and Regulatory Conditions - The most important aspect[29] of drone usage is governed by the DGCA (Directorate General of Civil Aviation) that lays down the guidelines and conditions under which drones can be procured and employed both, in the government as well as civil spheres of operation. It is through this that the challenge of tracking down illegal operation of drones comes into play, which can potentially disregard the surveillance intentions of certified operators.
3. Ethical Considerations - Lastly, the engineering of drones that are being employed plays a crucial role in achieving the tasks of ethical surveillance and monitoring. The prime challenge[30] faced is the alteration that may externally be incorporated into the drone systems by third party operators, which may cause for the drones to commit actions against

[28] Deva Priya, & Deva Priya. (2023, August 22). *What are Challenges Faced by Drone Technology?* Analytics Insight. https://www.analyticsinsight.net/drone/what-are-challenges-faced-by-drone-technology
[29] Ibid.
[30] Ibid.

the administered command. Furthermore, the aspect[31] of compromise in the surveillance matrix demands precise vigilance. This is characterised by the intentional disclosure of confidential matters of intelligence that are employed in the surveillance models either the enemy or a rival that may facilitate their attacks on the territory.

Conclusion

The requirement of employing drones in spheres of defence, civilian considerations as well as in the coherent context of surveillance is a growing prerogative. Seventy-five years since independence, it is only now that India has acknowledged the dire necessity of using UAVs and is also taking corrective measures to secure her boundaries and coastlines. While the usage of such machinery can require intensive effort by the army in terms of territorial land warfare, the practice of the same in the maritime context fails to have reached greater heights. On a primary stance, the government, while procuring high-end surveillance systems from partner states, must also aim at developing indigenous machinery at an accelerated pace. Secondly, the exercise of drones must have alternative usages, such as being employed in the civil sector to accustom the citizens to the prevalence of such systems while also encouraging them to promote the advent of drones in the civilian sector. On a third stance, the government and private sectors must invest in the enhancement of Research and Development (R&D) with respect to the implementation of UAVs, and simultaneously establish a calculative and sustainable approach to ensure the usage on a long-term perspective.

Acknowledging the developments in the field of surveillance and security through the usage of drones gains popular recognition specifically in India's context, wherein neither the land boundaries nor the maritime coastline is void of intentional extra-territorial attacks. Alongside the regulations and operational conditions of such technical advancements, a prime concern of ethical competency continues to remain a debated aspect of surveillance. Must the drones be used only in crisis situations that place the concerned operator in a situation of juxtaposition, or should they

[31] Ibid.

also be employed to illegally cross internationally demarcated borders and produce intelligence to avoid cases of juxtaposition is a point to ponder.

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