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THE ROLE OF UAVs IN THE CONTEXT OF MODERN BORDER CONFLICTS AND THREATS

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Abstract

This article examines the role of Unmanned Aerial Vehicles (UAVs) in 21st-century border conflicts and hybrid warfare, highlighting their tactical and strategic advantages, as well as the emerging threats they pose to national security. Furthermore, it analyzes how the evolution of drone technology is reshaping contemporary border defense systems.

Keywords: Unmanned Aerial Vehicles (UAVs), border security, asymmetric warfare, FPV drones, cyber threats, Electronic Warfare (EW), military logistics.

Introduction

The first quarter of the 21st century has entered human history as a period of profound crisis for international relations and the global security architecture. The international legal mechanisms established after World War II, which ensured relative stability for a long period, are losing their efficacy in many regions today. Consequently, long-standing frozen territorial claims have reawakened in various parts of the world, giving rise to a chain of intense border conflicts and hybrid wars of a new nature. The international security environment is undergoing fundamental changes, and the character of risks and threats associated with state borders is becoming increasingly complex. Beyond traditional military threats, challenges such as transnational terrorism, illegal migration, drug trafficking,

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arms smuggling, cybercrime, and elements of hybrid warfare are imposing new requirements on state border defense systems.

Today, factors threatening borders manifest themselves in the following key dimensions:

Illegal Migration

As a result of global economic inequality, armed conflicts, and environmental challenges, illegal migration flows are steadily increasing. Monitoring border regions stretching over thousands of kilometers solely through human resources is becoming increasingly difficult.

Transnational Crime

Border zones are frequently exploited as transit corridors for illicit activities, including narcotics trafficking, arms smuggling, human trafficking, and illegal financial operations.

Terrorist Threats

Terrorist organizations consistently seek to exploit border territories for unauthorized crossings, the transportation of weapons and financial resources, and clandestine movements.

Hybrid Threats

Modern conflicts are waged not only through conventional military means but also through elements of information, economic, and technological warfare.

Amidst this geopolitical turbulence, military strategies and doctrines of warfare are undergoing revolutionary shifts. Traditional concepts of war, which rely on massive tank divisions, frontal aviation, and large-scale manpower – all requiring immense economic resources – are failing to yield the expected results in today's military engagements. These heavy and slow-moving military apparatuses are

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yielding ground to high-tech, highly agile, and, most importantly, relatively cost-effective and remote-controlled systems. At the core of this military-technical revolution lies the technology of Unmanned Aerial Vehicles (UAVs), or colloquially, drones.

Border conflicts observed in recent years across Central Asia, the Middle East, the Caucasus, Eastern Europe, and Africa have compelled states to monitor their borders using modern technologies. In this context, Unmanned Aerial Vehicles (UAVs) are being recognized as one of the most effective instruments for ensuring border security.

Unmanned aerial vehicles are becoming an integral component of the border security system. This is primarily due to their operational advantages, such as long-range surveillance, real-time data transmission, execution in environments hazardous to human life, high-precision monitoring, rapid deployment, and relative cost-effectiveness.

A significant portion of border territories is characterized by mountainous, desert, or rough terrains that are difficult to access. Continuous monitoring of such areas demands substantial financial and human resources. Through the deployment of UAVs, capabilities are generated for patrolling along the borderline, detecting suspicious activities, monitoring illicit crossing routes, and inspecting the condition of border infrastructure. Furthermore, drones equipped with thermal imaging and night-vision systems can conduct surveillance at any time of the day. Recent military conflicts have clearly demonstrated the combat and reconnaissance capabilities of UAVs. In the Russia–Ukraine conflict, various categories of drones have been extensively utilized for reconnaissance, artillery fire correction, border monitoring, and logistics control. Similarly, during the Armenia –Azerbaijan conflict – specifically the 2020 Nagorno-Karabakh conflict – drones became a pivotal element of military operations. They were actively used to detect enemy positions, track military hardware, and transmit operational

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data. This experience underscored the critical importance of continuous aerial monitoring in border regions.

Previously, state border defense was confined to linear (two-dimensional) defense systems, which included constructing engineering fortifications and barbed wire fences along a specific perimeter, establishing minefields, and deploying border posts consisting of manpower. However, the massive introduction of UAVs into the battlefield has completely redefined the concept of border security, imbuing it with a vertical and asymmetric character. Today, threats to national security emerge not merely from the ground surface but also through the micro-level of airspace (low altitudes).

This trend has manifested itself vividly in the proxy wars of the Middle East, the clashes in Nagorno-Karabakh, and large-scale military operations in Eastern Europe. Drones have evolved into the “air fleets” not only for the militaries of major powers but also for small nations with limited financial capacities, and even for illegal armed groups. This paradigm shift has engendered entirely new risks and vulnerabilities in protecting strategic borders.

Modern UAVs are increasingly being integrated with artificial intelligence (AI) elements. AI technologies facilitate automated object detection, classification of suspicious behaviors, differentiation between humans and vehicles, trajectory forecasting, and threat level assessment. Consequently, the cognitive workload on the operator is reduced, and the decision-making process is significantly accelerated (tables 1-2).

As a result, many countries around the world are transitioning toward the “Smart Border” concept. Within this system, a fully integrated ecosystem operates, comprising:

- Unmanned Aerial Vehicles (UAVs);
- Video surveillance systems;
- Radar complexes;
- Ground sensors;

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Artificial intelligence platforms;

Geoinformation systems (GIS).

Such a comprehensive approach substantially enhances the overall efficiency and effectiveness of border security frameworks.

Table 1. Functional Capabilities of Unmanned Aerial Vehicles (UAVs) in Countering Modern Border Threats

Type of Threat	Primary Function of UAVs	Expected Outcome
Illegal Migration	Border surveillance and monitoring	Detection of illegal border crossings
Smuggling	Tracking suspicious vehicles and movements	Identification of illegal cargo and contraband
Terrorism	Reconnaissance and patrol operations	Prevention of terrorist activities
Hybrid Threats	Situational monitoring and intelligence gathering	Provision of real-time operational information
Emergency Situations	Search and rescue operations	Rapid emergency response and assistance

Table 2. Comparison of Traditional Border Control Systems and UAV-Based Border Surveillance Systems

Indicator	Traditional Border Control	UAV-Based Border Control
Surveillance Coverage Radius	Low	High
Response Speed	Moderate	High
Cost Efficiency	Moderate	High
Operation in High-Risk Areas	Limited	Extensive Capability
Real-Time Information Availability	Limited	Comprehensive
Night Surveillance Capability	Partial	Highly Effective

Source: Compiled by the author based on the analysis of international practices in border security and the application of UAV technologies.

Unmanned aerial vehicles (UAVs) have traversed a complex evolutionary path, transforming from simple surveillance tools into multi-functional combat

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systems. Today, in terms of ensuring border security and countering prospective threats, UAVs are classified into four primary strategic categories based on their operational roles and technical capabilities:

• **Operational-Strategic Reconnaissance UAVs (MALE and HALE Classes):**

This category includes platforms such as the US *MQ-9 Reaper*, the Turkish *Bayraktar TB2* and *Akinci*, and the Chinese *Wing Loong*. These assets are capable of Medium-Altitude Long-Endurance (MALE) and High-Altitude Long-Endurance (HALE) operations. Equipped with advanced optoelectronic, infrared, and radar surveillance stations, these massive platforms can conduct round-the-clock monitoring of enemy territory hundreds of kilometers deep without physically crossing state borders. Their primary mission is the early detection of enemy reserve force deployments, logistical routes, and military infrastructure adjacent to border zones.

• **Loitering Munitions (Kamikaze Drones):** Systems such as *Lancet* (Russia), *Switchblade* (USA), and *Harop* (Israel) operate in a loitering munition mode. They patrol designated airspace, locate targets autonomously, and strike them either upon operator command or via embedded artificial intelligence algorithms. In border clashes, these drones serve as highly effective strike assets designed to neutralize the enemy's air defense (AD) systems, radar installations, and command posts, effectively "blinding" the opposing defensive lines.

• **Tactical and Micro-Drones (Quadcopters):** These represent militarized and software-modified variants of commercial quadcopters, such as the *DJI Mavic* series. They have fundamentally altered the paradigm of trench warfare directly on the frontlines and at border security outposts. At the tactical level, these small devices provide every platoon or squad with its own "aerial eye." Currently, their capabilities have advanced to real-time artillery fire adjustment and the tracking of individual adversarial movements.

• **FPV (First-Person View) Strike Drones:** This asset stands out as one of the most significant combat innovations in recent conflicts. Utilizing specialized

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video goggles, the operator maneuvers the drone via a first-person real-time video feed. Due to their high velocity and extreme maneuverability, these small, explosive-laden drones can precisely target the most vulnerable sections of armored vehicles (such as hatches or engine compartments) or pinpoint positions inside trenches. Their minuscule signature and high operational speed render neutralization by conventional firearms or heavy air defense systems nearly impossible.

The most profound paradigm shift UAVs have introduced to military science is the radical transformation of combat and defense economics into an asymmetric model. Traditional doctrines dictated that achieving victory required an economy anchored by a multi-billion-dollar military-industrial complex, heavy metallurgical infrastructure, and massive financial reserves. Drone technology has thoroughly disrupted this capital-intensive equilibrium. Today, a single FPV drone assembled from commercial off-the-shelf components costing approximately \$500 can destroy a modern main battle tank valued at over \$5 million, provided the operator possesses sufficient expertise. Similarly, loitering munitions worth a few tens of thousands of dollars can entirely neutralize strategic radar stations valued at \$20 million. This severe economic disparity has initiated a fundamental turning point in border defense and counter-hybrid threat frameworks.

This economic asymmetry is primarily evident in the **drastic reduction of the logistical burden** associated with combat operations and border defense. Sustaining a conventional artillery division or an armored formation with weaponry, fuel, and ammunition demands tons of cargo transport, railway infrastructure, and a sophisticated supply chain. This complexity leaves logistical networks highly vulnerable to interdiction. UAVs have mitigated this vulnerability: a detachment of strike drones, along with their control stations and explosive payloads, can be easily and covertly transported within a single standard civilian vehicle. Concurrently, this small footprint can fully deliver the

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pinpoint precision strike efficacy that previously required tons of heavy artillery shells.

The second and more systemic challenge involves the **deepening crisis within national defense budgets**. In contemporary security environments, states are compelled to deplete high-value surface-to-air missiles (*Patriot*, *S-400*, and similar complexes) valued between \$1 million and \$3 million to counter massed incursions of inexpensive drones that cost under \$10,000 on international markets. This dynamic generates a distinct economic paradox capable of exhausting the financial reserves of even the wealthiest and most formidable global economies during protracted border attrition. Consequently, modern defense strategies are confronted with the critical imperative of developing counter-measures that are more cost-effective than the incoming offensive drone threats.

The pervasive deployment of unmanned aerial vehicles in contemporary border conflicts introduces unprecedented precedents and complex legal-tactical scenarios for international legal norms, sovereign integrity, and national security systems. By eroding traditional linear boundaries, drones have introduced highly covert and asymmetric methodologies for projecting threats against state security. The most dangerous manifestation of these new-era threats is “Grey Zone” operations and the anonymity of attacks. Drones provide an aggressor with the capability of **plausible deniability**. For instance, if a strategic border facility, an oil refinery, or a major ammunition depot of a state is detonated from the air by an unidentified apparatus, proving legally and technically which specific state or group carried out the attack within a short timeframe becomes exceedingly complex. This identification dilemma paves a wide path for revisionist states to weaken an adversary country’s infrastructure from within and exert political pressure, while successfully evading international sanctions or direct retaliatory military strikes.

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Concurrently, a digital transformation of transnational organized crime is being observed along borders previously deemed inviolable. Today, narcotics cartels, arms traffickers, and international human trafficking networks utilize heavy-payload autonomous drones to bypass ground sensors, physical engineering barriers, and border patrols in rugged mountainous, forested, or desert borderlands. Operating on pre-programmed digital maps and GPS/GNSS coordinates— independent of operator control and without radio communication links—these aerial platforms largely render multi-billion-dollar ground-based engineering and fortification systems obsolete. This underscores that border security can no longer rely solely on surface-bound forces.

Finally, the most daunting cyber-threat in near-future military strategy is “**Swarm Intelligence**” driven by artificial intelligence. In this scenario, the requirement for remote human operator commands is eliminated; dozens or hundreds of micro-drones communicate via a localized network to execute a coordinated strike on a strategic asset under a unified collective algorithm. If a swarm of 50 to 100 such drones simultaneously converge on a border outpost, conventional Electronic Warfare (EW) assets fail to yield the expected efficacy. Because the units within the swarm do not rely on external control signals, even if a portion of them is neutralized in mid-air, the remaining drones automatically redistribute the combat mission and execute it to completion. This demands an entirely different, digital speed of response from defensive frameworks.

The global scale of the threats posed by unmanned aerial vehicles demonstrates that they cannot be effectively countered using only conventional firearms, assault rifles, or machine guns. In contemporary environments, reliable state border defense necessitates the creation of an integrated, three-tiered **Anti-UAV ecosystem** that encompasses early detection, electronic counter-measures, and kinetic neutralization phases.

The primary foundation of this ecosystem consists of **early detection and multi-spectral surveillance systems**. Because modern micro and tactical quadcopters

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are predominantly manufactured from plastic, carbon, and other composite materials, and travel at extremely low altitudes, conventional large-scale military radar installations cannot detect them. Therefore, border zones must integrate specialized Doppler radars capable of identifying low-signature targets, acoustic sensors that isolate the distinct acoustic signature of drone engines and propellers from kilometers away, and AI-driven optical stations that analyze thermal and visual anomalies within seconds. Such a multi-layered monitoring network enables the detection of adversarial assets long before they approach the border perimeter.

The second and most widely deployed echelon of defense involves **electronic jamming and spoofing technologies**. Rather than physically fragmenting the drone in mid-air, this method directly disrupts its digital “brain” and navigation matrix. Modern anti-drone rifles and large-scale stationary EW complexes completely suppress the radio frequency channels linking the apparatus to its operator, as well as satellite navigation signals (GPS, GLONASS, BeiDou). The most advanced direction in this field is **GPS spoofing**, which transmits fabricated geographical coordinates to the hostile UAV. Consequently, the drone miscalculates its position—believing it is in an entirely different, safe zone—loses its orientation, crashes, or loses control and returns to the aggressor's own base.

If the enemy drone is programmed in a fully autonomous mode and exhibits complete immunity to electronic signals, the third echelon is activated: **kinetic and laser-based physical neutralization assets**. Since intercepting micro-drones with high-cost missiles induces economic exhaustion, relatively inexpensive alternative methods are deployed along borders. These include **Directed Energy Weapons (DEW)** or lasers that blind the drone by instantly burning out its optical sensors and cameras; high-velocity, programmable airburst ammunition that detonates forward of the aerial target to generate an impenetrable cloud of shrapnel; and specialized “hunter drones” that capture the hostile asset

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by launching a durable net over it. Only the synchronization of these digital and kinetic instruments can elevate modern border security to an absolute standard. If the aggressor's unmanned apparatus operates in a fully autonomous mode without relying on radio communication channels—guided instead by artificial intelligence maps and internal software algorithms—electronic warfare assets lose their efficacy, and such targets must be physically neutralized in mid-air. Because expending million-dollar missiles to down low-cost drones is economically unsustainable, next-generation kinetic and thermal weapons with low per-shot costs take precedence in modern border defense. Foremost among these are directed energy or laser weapons that incinerate the sensitive optical sensors, cameras, and thermal imagers of an incoming drone within a fraction of a second, rendering it entirely blind. Concurrently, automated anti-aircraft systems equipped with high-velocity, programmable ammunition are widely utilized to calculate the exact coordinates of the aerial target and detonate a fragmentation barrier directly in its flight path. As an unconventional tactical solution, specialized “hunter drone” systems that cast a heavy-duty net over the hostile UAV to block its rotors and force it to the ground are yielding highly effective results. Only the interoperability of these kinetic and high-tech measures establishes a reliable shield against autonomous threats.

In the context of 21st-century military-political conflicts and hybrid threats, unmanned aerial vehicles have evolved from simple auxiliary technical tools into the primary factor determining the fate of the battlefield and strategic borders. The rapid evolution of UAVs into operational-strategic, loitering munition, tactical, and FPV variants has fundamentally revolutionized both traditional combat tactics and state border defense architectures.

The most profound revolution triggered by drones is the **asymmetry in the economics of warfare**. The reality that a basic device costing a few hundred dollars can destroy heavy armored vehicles or radar installations valued at millions of dollars has shifted the strategic equilibrium to the detriment of large

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states wealthy in conventional hardware and resources. Concurrently, the peril of anonymity in "Grey Zone" operations, the migration of transnational criminal smuggling routes into the airspace, and the looming near-future threat of AI-driven "drone swarms" necessitate an entirely fresh approach from national security apparatuses.

The increasing complexity of contemporary border conflicts and security challenges demands innovative technological solutions for state border protection. Unmanned aerial vehicles are becoming vital instruments in ensuring border security by facilitating real-time surveillance, gathering reconnaissance data, detecting illicit activities, and supporting rapid operational decision-making processes.

UAV complexes integrated with artificial intelligence, advanced sensor suites, and geoinformation technologies (GIS) will serve as the core element of the "Smart Border" concept in the future. Therefore, the widespread implementation of modern UAV technologies within the operations of border troops stands as a top priority for safeguarding national security.

In conclusion, the territorial integrity and inviolability of state borders today depend not merely on manpower or classical standing armies, but on the degree of **digital control established over the micro-level of airspace**. Modern border defense must transcend the mere possession of a drone fleet; it must systematically implement a three-tiered anti-UAV ecosystem comprising multi-spectral early detection, electronic warfare (EW), cyber-interception, and next-generation laser-kinetic weaponry. The security of tomorrow is contested and decided within the laboratories of intellectual defense and high technology; consequently, achieving digital supremacy in this domain is a vital necessity for every sovereign state.

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