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Studying the Invasion of Drones in Indigenous Areas Using Machine Learning Techniques

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ABSTRACT The prevalence of drones in contemporary times has become widespread, representing a pivotal technologicaladvancement in aviation—characterized by its autonomous, pilot-less nature. However, its predominant application for surveillance and targeted operations, particularly by the United States of America (USA), has sparked vehement criticism dueto perceived violations of human rights on a global scale. Especially, Pakistan-like countries have borne the brunt of drone strikes, with the Federally Administered Tribal Areas being the primary target, accounting for over 90% of these attacks. Thisresearch delves into the profound impact of drone strikes, focusing on the often-overlooked innocent victims, including womenand children, as well as the consequential damage to the affected regions. In this paper, we posit that a classification-based approach offers a more comprehensive and statistically informative means of elucidating patterns inherent in the data. By doingso, we aim to shed light on the effectiveness of targeted killings in the context of counter-terrorism. The proposed approach includes machine learning algorithms, such as ZeroR, J48, Naive Bayes, and OneR that have been employed to meticulously analyze the dataset and unveil hidden patterns. In particular, the J48 algorithm demonstrated exceptional performance, accurately discerning casualties within the standard Kaggle noisy dataset. The Weka tool, known for its advanced capabilities,played a pivotal role in this analysis, handling crucial tasks such as initial pre-processing, numeric to nominal conversion, andreplacing missing values. This integrated approach ensures a robust exploration of the dataset, leveraging the strengths of diverse algorithms and sophisticated tools for comprehensive insights. This departure from traditional legal analyses broadensthe discourse surrounding drone warfare, emphasizing the importance of data-driven insights in understanding the broader implications of these operations.

INDEX TERMS: Drone attack, civilian, Data Mining, Pattern Analysis

I. INTRODUCTION

Unmanned Aerial Vehicles (UAVs), commonly referred to as drones, have become synonymous with modern aviation [1]. The initiation of drone attacks traces back to June 2004 under the administration of George Bush in Pakistan. However, it was during the tenure of Barrack Obama that these strikes witnessed a substantial surge. Pakistan, in particular, emerged as the primary theater for such operations,overshadowing the prevalence of drone activities in other nations. The Federal Administered Tribal Areas of Pakistan,including North & South Waziristan, Bajawer Agency, Kuram Agency, Bannu, and Hangu, have predominantly been the focal points of these targeted missions.

The Federally Administered Tribal Areas (FATA) [2], situated at the border with Afghanistan, have emerged as the epicenter of joint operations conducted by the USA and Pakistan against terrorist activities. This shared border has rendered the FATA regions highly susceptible to the impact of these collaborative efforts. Following the USA's intervention in Afghanistan, a substantial influx of Taliban members sought refuge in these Tribal areas, with local communities generously providing shelter to the influx of refugees. Within these territories, the Taliban found fertile ground for sustenance, and the USA contends that the FATAareas have inadvertently become breeding grounds for Jihadist Organizations. Moreover, assertions have been made regarding the existence of training centers where the Talibanundergo systematic training.

Following the 9/11 event [3] [5], the FATA regions swiftly transformed into a focal point of substantial unrest. The insurgent ratio experienced a notable surge, prompting the Pakistani Government to grapple with the formidable challenge at hand. Recognizing the gravity of the situation, the USA advocated for proactive measures, urging the Pakistani Government to implement control mechanisms in these Tribal Areas. Subsequently, in 2004, the USA intensified its commitment to counter-terrorism efforts, initiating the use of UAVs for targeted strikes against prominent figures such as Al-Qaeda and Taliban leaders. This marked a pivotal shift in the tactics employed in the region.

The anti-terrorism policy, instead of yielding positive outcomes, has become a source of numerous challenges. The repercussions have been particularly severe for the lives of innocent civilians [4]. The toll is staggering, with thousands of individuals, including women and children, bearing the brunt of these consequences. Many have been left disabled, some succumbing to injuries in hospitals. The widespread impact has prompted hundreds of families to abandon their homes, seeking refuge in other regions. Drone strikes, beyond their immediate physical consequences, cast profound and lasting effects on the social, economic, and psychological facets of individuals' lives.

A distinct and pervasive fear has permeated the lives of residents due to drone strikes. Compounding this, a significantissue arises from the plight of innocent individuals who, without any discernible cause, find themselves bereft of homes and families. For many among them, this grievous loss transforms into a vehement opposition to their government and military. This opposition evolved into a perilous form with the rise of suicide bombing attacks. Having lost everything dear to them, the affected individuals perceive their lives as less valuable, fueling a desperate turn toward suicidal acts against the government and public sectors. The perplexing question of why their Muslim government seemingly endorses the killing of its citizens festers in their minds. Moreover, a stark reality emerges that a mere 10% ofthe casualties resulting from drone strikes are genuine terrorists. In this grim scenario, the sacrifices made by local people stand as poignant testaments to the far-reaching consequences of such actions.

The United States maintains a veil of secrecy over the precise details of damages and casualties resulting from drone strikes, refraining from divulging accurate data. Nonetheless, select media channels have undertaken the task of collating information and presenting it to the public, albeit with certain assumptions. Numerous research endeavors have been undertaken to aggregate data from diverse sources, resulting in the publication of various papers. Each of these papers approaches the subject of drone attacks in Pakistan from distinct perspectives, adding layers of nuance to the discourse. In this context, our paper endeavors to contribute to this bodyof knowledge by meticulously analyzing the dataset provided by Pakistan Body Count—a recognized authority for accuracyin Pakistan's information landscape.

Numerous analyses have been conducted on the identicaldataset, exploring diverse dimensions such as attacks by time,attacks by day, attacks by month, and attacks by year. Consequently, a comprehensive picture emerges, delineating the total number of casualties and injuries, albeit with slight variations. Our primary focus lies in discerning the ramifications of drone strikes on innocent victims, delving into the multifaceted repercussions in terms of social, economic, and psychological aspects. By honing in on these specific dimensions, we aim to illuminate the nuanced impact that extends beyond mere numerical statistics.

II. LITERATURE REVIEW

In the scrutiny of drone attacks, Mahmood [6] has astutely probed their legal standing within both international law and the domestic legal framework of the United States. While these strikes are ostensibly targeted at terrorists, Mahmood notes a considerable number of civilians falling victim, prompting significant criticism from the Pakistani populace. The observation contends that drone attacks lack legality under both international and U.S. domestic law, raising questions about their justification within the legal frameworks. Furthermore, it underscores a glaring lack of transparency on the part of the United States in the executionof these operations.

Alcides Eduardo [7] delves into the legal constraints surrounding the use of UAVs. The study highlights a disconcerting reality—despite the presumed precision and visual acuity of UAVs, over a quarter of those killed in a decade were civilians. Strikingly, the percentage of high-priority targeted terrorists stood at a mere 2%. The process of identifying adversaries relies on patterns such as area height and details about an individual's social life. However, a critical flaw surfaces: when the enemy is identified using these patterns, individuals related to them inadvertently fall within the target domain. This practice of identifying enemies while inadvertently causing harm to innocent individuals is both critical and, according to Eduardo, woefully insufficient.

Sarah E Kreps [8] underscores the pivotal role of public opinion and support in shaping enduring and legitimate government policies. From the governmental perspective, drone attacks are deemed effective in both disrupting terrorists and aligning with international law. However, a contrasting narrative emerges from international organizations (IO) and non-governmental organizations (NGO), contending that these strikes not only violate international law but also contribute to an escalation of terrorism rather than curbing it. Through experimental surveys, Kreps concludes that the criticisms from IOs and NGOs wield significant influence over public attitudes, even in the realm of crucial national security issues like drone strikes. This insight accentuates thenuanced interplay between public perception, government policies, and the assessments of international entities.

Kathrin Maurer [9] contributes a unique perspective by arguing that while there has been significant attention on thepolitical, ethical, and legal dimensions of drone strikes, the visual framing aspects often remain unexplored. With the specific aim of elucidating the visual landscape of military drones, Maurer conducts a detailed analysis of their visual configuration. The article delves into the intricate process of how individuals are targeted by drone operators, creating a framework of visual recognition that delineates whom to include or exclude from the scope of pursuit. The conclusion drawn is nuanced—while drone warfare holds the potential tosave lives, its efficacy hinges on a carefully calibrated grammar of

TABLE 1.
References of recent related published articles are shown below

No.	Author	Year	Problem Statement	Solution
1.	Amna Mahmood &Sadaf Farooq	2015	To focus on the justification and legal position of Drone attacks within the boundaries of a sovereign state	Drone attacks are not supported by international law
2.	Alcides Eduardodos Reis Peron	2014	From the accuracy and visual capacity of The UAVs, information on the deaths of civilians, and legal limitations in International Humanitarian Law.	Would help establish the legitimacy of such targeted killings b/w civilians or Taliban
3.	Sarah E Kreps	2016	How criticisms impact public support for drone strikes	Criticisms focusing on theeffectiveness of strikes have little impact on the public.
4.	Kathrin Maurer	2016	Research often focuses on the political, legal, and ethical aspects of this drone strike violence;	It is shown how the scope regime of military drones executes violence as a form of man-hunting.
5.	Jonathan Kennedy	2017	Drone strikes in FATA have disrupted efforts to eradicate polio. Drone strikes and polio have not yet been systematically investigated.	It is recognized that vaccination programs were a Cover for espionage.
6.	Katharine Hall Kindervater	2016	ISR capabilities are directly linked to targeted killing, effectively merging mechanisms of surveillance and knowledge production with decisions on life and death.	Lethal surveillance and the drone strike reflect a tendency. This not only allows us to connect the drone to other practices of war and security but as a practice that falls squarely within the history and development of Western warfare and violence.
7.	Milena Sterio	2012	battlefield and the applicability of the law of armed conflict; the identity of targetable individuals and their status as combatants or civilians under international law;	If the USA truly engaged with the Taliban, it can be argued that drone attacks are not so illegal. Issues that remain unanswered are those regarding the nature of the conflict that the United States has been engaged in since 9/11,
8	Dennis G. Barten , Derrick Tin, Harald De Cauwer, Robert G. Ciottone, Gregory R. Ciottone	2022	focuses on assessing the medical challenges and responses associated with drone attacks in counter-terrorism scenarios, with a specific emphasis on understanding the injuries and medical requirements resulting from such incidents.	They discuss strategies for enhancing medical response and preparedness in the face of drone attacks, aiming to develop effective measures to address injuries and casualties resulting from such incidents in counter-terrorism operations
9	Zhambyl Shaikhanov, Sherif Badran, Josep M. Jornet, Daniel M. Mittleman, Edward W. Knightly	2023	concerns the development and potential risks associated with deploying metasurface-equipped drones for remote attacks, requiring examination of security and technological challenges in mobile computing systems and applications.	The article may propose methods to detect and defend against drone attacks using metasurfaces, addressing the emerging security concerns posed by remotely positioned drones equipped with advanced technology in mobile computing systems and applications.

visual exclusion and bi-political power that must be meticulously accurate.

Maurer's exploration underscores the significance of understanding the visual dynamics inherent in drone operations for a comprehensive evaluation of their impact.

In Jonathan Kennedy's examination [10], the focus shiftsto the polio vaccination mission viewed through the lens of drone strikes. Notably, the areas targeted align significantly with regions where polio vaccination groups were actively engaged between 2004 and 2012. Kennedy brought attention to the claims made by militants, asserting that polio vaccination campaigns

served as a front for gathering covert information intended for the Central Intelligence Agency (CIA) to identify specific targeted individuals. The repercussions were stark—militants successfully disrupted immunization campaigns. Intriguingly, from 2013 onward, asdrone attacks diminished, there was a dramatic surge in poliocases. Kennedy posits that this shift marked an attempt by the CIA to exploit fake immunization campaigns in a bid to obtain Osama bin Laden's DNA, thereby revealing that these seemingly innocuous vaccination programs were, in fact, a strategic cover for espionage.

Katharine Hall Kindervater [11] explores and scrutinizes the revolution brought about by drone technology, delving into its historical evolution in surveillance and targeting and elucidating how it has fundamentally shaped contemporary drone warfare. Her observation unfolds to reveal two pivotal trends within Western warfare—a burgeoning demand for intelligence, surveillance, and reconnaissance (ISR), and the concurrent development of dynamic targeting, both becoming ever more intricately interwoven. The convergence of these trends manifests in the contemporary landscape as a form of lethal surveillance, wherein ISR capabilities are seamlessly tethered to targeted killing. Kindervater's analysis provides valuable insights into the evolving dynamics of warfare, shedding light on the symbiotic relationship betweenintelligence gathering and precision targeting in

TABLE 2.
Comparison of recent published articles' results based on attribute

No.	Paper author	Legality by international law	Follow the principles of Just War/Jus in Bello	civilian casualties	Priority Target	Effective at killing terrorists	Public Attitude
1.	Mahmood, A., S. Farooq, and A. Karim,	Illegal	No	>50%		No	
2.	Dos Reis Peron, A.E	Illegal	No	22%	<2%	No	
3.	Kreps, S.E. andG.P.	Illegal	No		2%	No	International legal principles significantly altered
4.	Maurer, K.	Illegal		>50%		No, Visual field model	
5.	Kennedy, J.	Illegal		>50%			Boycotted the vaccination programs in 2012
6.	Kindervater, K.H.	Illegal	No				
7.	Sterio, M.	Illegal	No			No	
8	Dennis G. Barten , Derrick Tin, Harald De Cauwer, Robert G. Ciottone, Gregory R. Ciottone	Illegal	No		2%	No	
9	Zhambyl Shaikhanov, Sherif Badran, Josep M. Jornet, Daniel M. Mittleman, Edward W. Knightly	Illegal	No	>50%			

the context ofdrone warfare.

Milena Sterio [12] delves into the intricate debate surrounding the compliance of drone attacks with the principles of jus in Bello. The United States has faced widespread criticism from numerous international communities regarding the geographic application of drones against Al-Qaida forces. However, it's noteworthy that six officials within the Bush Administration staunchly defendedthe drone program, asserting its consistency and alignment with international law. Stereo prompts a critical inquiry into the legality of drone strikes under the jus in Bello law. The fundamental question emerges: is there a legitimate framework for the legal use of drones? Stereo posits that if a military commander were to opt for a drone attack against a well-known military target, and such an attack could substantially advance military objectives without causing disproportionate harm to civilians or unnecessary suffering, then such a drone strike could indeed align with the principles of jus in Bello. This nuanced exploration underscores the complexity and nuanced considerations inherent in evaluatingthe legal parameters of drone warfare.

Barten et al. [13] appear to delve into the multifaceted realm of medical implications and responses associated withdrone attacks in the context of counter-terrorism endeavors. While the specific details of the article are currently inaccessible to me, the framing suggests a comprehensive exploration of the injuries and medical challenges arising fromdrone strikes in conflict zones. The focus extends to strategizing effective medical assistance in these challengingsituations. This study holds the promise of offering valuable insights into the intricate intersection of medicine and counter-terrorism efforts. By shedding light on the medical dimensions of drone warfare, it could potentially inform strategies for mitigating the health-related consequences of such operations.

Zhambyl Shaikhanov et al. [14] appear to concentrate their focus on the innovative concept of incorporating metasurfaces in drone attacks conducted remotely. The anticipation is thattheir work explores the technological intricacies and potential implications of employing metasurfaces in the realm of droneattacks, particularly in the context of mobile computing systems and applications. This suggests an investigation into the intersection of advanced technology, such as metasurfaces, with the evolving landscape of drone-based operations. By contemplating the potential utilization of metasurfaces, the study may provide insights into the evolving dynamics of drone technology and its applications in remote and mobile computing scenarios.

III. METHODOLOGY

The methodology has been adopted to address a critical gap in existing research, which often emphasizes the legality of drone strikes under international and domestic law, neglecting the substantial impact on individuals and communities. Our proposed approach revolves around employing classification algorithms to uncover hidden patterns within the dataset through the application of data mining techniques. We leverage the sophisticated capabilitiesof the widely recognized tool, "Weka [15]," designed for advanced data mining tasks. It is an advanced-level tool for data mining tasks. The proposed flow model is presented in the below figure.

Initially, the dataset, sourced from Kaggle, was characterized by its noisy and incomplete nature. To enhance its suitability for analysis, we initiated a pre-processing phase within Weka. This involved crucial steps such as converting numeric values to nominal ones and employing a filter to replace missing values. These measures were pivotal in preparing the dataset for in-depth analysis.

The core of our methodology lies in the selection of a classification algorithm. This algorithm was applied to scrutinize the data, bringing forth discernible patterns. The successful execution of this process led to the discovery of valuable insights based on the identified patterns, thereby contributing to a deeper understanding of the nuanced implications of drone strikes beyond the legal realm. A classification algorithm is selected to perform the analysis ofdata, which present patterns, and after that, we succeeded in knowledge discovery on those patterns base.

a. Results and Discussion

We have focused on diverse algorithms accessible within Weka [16]. Specifically, we chose to employ classification-based algorithms, namely ZeroR, J48 [17], Naive Bayes [18],and OneR. The ensuing table elucidates the accuracy results of these selected algorithms across various attributes. The evaluation aimed to discern the performance of various algorithms across key attributes. Notably, time-based analyses revealed consistent patterns among all algorithms. Further exploration into location-based analyses showed subtle differences, especially between ZeroR and J48, indicating nuanced distinctions in their predictive capabilities.

Significant disparities emerged in analyses related to the number of injuries, civilian deaths, and total casualties. J48 consistently outperformed other algorithms in these critical categories, suggesting its potential superiority in accurately identifying and predicting the impact of drone strikes on individuals, emphasizing its efficacy in gauging the human cost of operations. An intriguing finding from time-based analyses unveiled a concentration of attacks at 10 am, shared across all algorithms. This temporal pattern prompts further inquiry into reasons for this specific timeframe, possibly revealing strategic considerations or operational factors influencing the timing of drone strikes. In essence, while consistencies were observed in temporal and locational analyses across algorithms, variations in predicting casualties highlight the nuanced performance of each algorithm. These outcomes underscore the importance of thoughtful algorithm selection based on specific attributes of interest in drone strikeanalyses [Table 3].

TABLE 3.
Accuracy results based on algorithms

Algorithm	Time	City	Injured	No of Strikes	Civilian Death	Total Died
ZeroR	58%	72%	39%	77.7%	24%	15%
J48	58%	72%	39%	77.7%	55%	57%
NaiveBayes	56.6%	69%	37%	76.8%	36%	37%
OneR	56%	63%	36%	77.2%	23%	8%

b. Time-based analyses

According to the proposed result findings, over 50% of attacks were executed at 10 am, with ZeroR and J48 yieldingidentical results [figure 1].

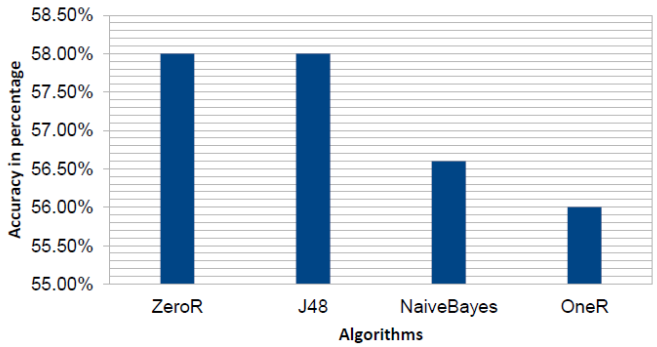

Figure 1. Time-based accuracy in percentage by applying the algorithms

c. Location-based analyses

All the listed algorithms present the highest number ofattacks performed in North Waziristan, the results are the same between ZeroR and J48 3% higher than NaiveBayesand 5% higher than OneR [figure 2].

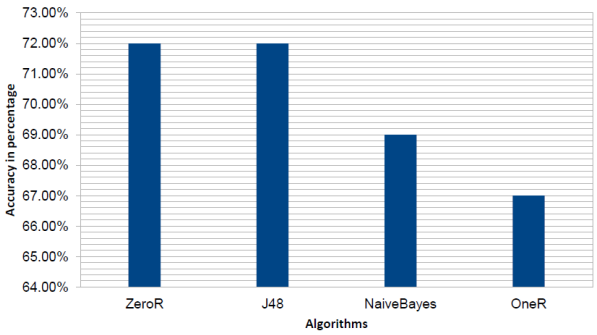

Figure 2. Location-based accuracy in percentage by applying the algorithms

d. Number of Injured People Analysis

The number 5of injured people is truly classified by differentalgorithms as given in the graph [figure 3].

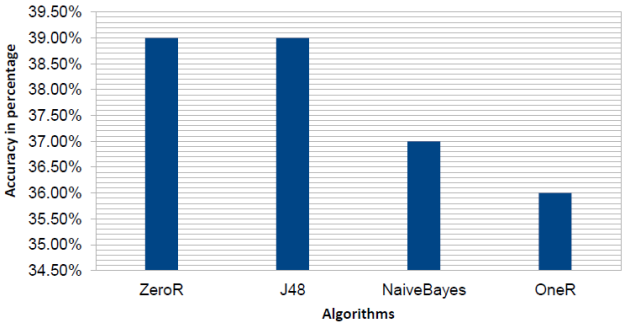

Figure 3. No. of injured people based on accuracy in percentage by applying the algorithms

e. Civilian Death Analysis

In this attribute analysis, the J48 outperformed, evaluatingthat more than 50% were civilians [figure 4].

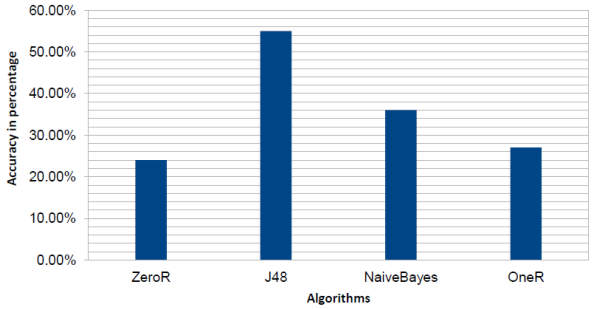

Figure 4. Civilian death-based accuracy in percentage by applying the algorithms

f. Total Death Analysis

In this attribute, all algorithms showed different resultswhere J48 is more accurate than all others [figure 5].

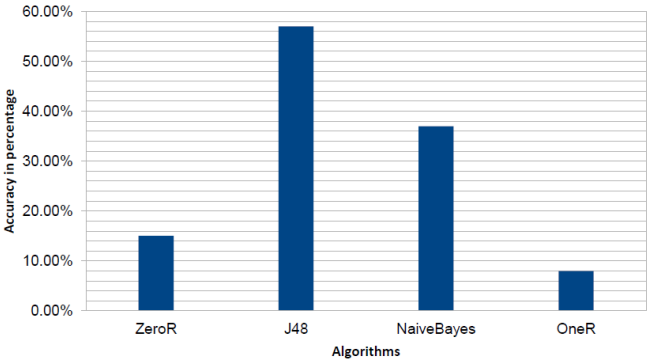

Figure 5. Total death-based accuracy in percentage by applying the algorithms

g. Merged Results Chart

After evaluation, it is clear that all the listed algorithms performed almost the same on the first three attributes time, location, and no of strikes while the results vary on the last [figure 6].

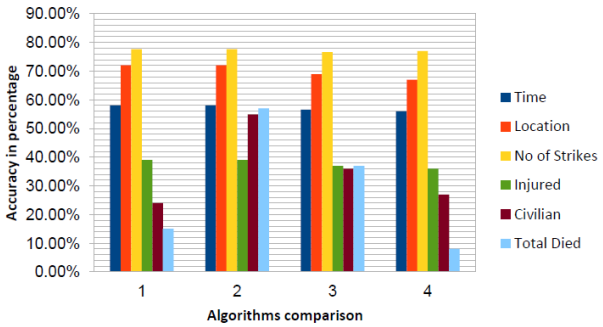

Figure 6. Merged all the above results

IV. CONCLUSION

The analysis of drone strikes has consistently captivated researchers, with a predominant focus on the legality of such operations within national and international legal frameworks. However, a critical gap exists in understanding the profound impact of these strikes on innocent lives. This study delves into the dataset, exploring various attributes to comprehensively examine the consequences of drone strikes.The temporal analysis reveals a striking pattern, with over 50% of attacks concentrated at 10 am. This temporal specificity raises intriguing questions about the strategic considerations or operational factors influencing the chosen timeframe for drone strikes. Furthermore, location-based analyses underscore North Waziristan as the most targeted area, shedding light on the geographical dynamics of drone operations. One of the most significant outcomes is the revelation of substantial civilian sacrifices compared to the intended targets. The algorithms, particularly J48, consistently outperformed others in accurately identifying and predicting the human cost of drone strikes. This finding emphasizes the urgent need for a nuanced understanding of the impacts, especially on civilians, when assessing the efficacy of drone operations. Finally, the study providesvaluable insights into the multifaceted aspects of drone strikes, transcending the discourse on legality. The nuanced performance of algorithms and the observed patterns in timeand location analyses highlight the complexity of this issue. It is imperative for future research and policy considerationsto account for the intricate dynamics and human costs associated with drone strikes.

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