Article

Leveraging Artificial Intelligence (AI) Technology for Enhanced Border Surveillance at the Malaysia-Thailand Land Border

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Abstract: Despite various initiatives taken by the government, Malaysia shows a trend of increasing migrant smuggling. Weaknesses in the border control management have resulted in the escape of smugglers at the border gate. Thus, this article aims to assess the potential application of artificial intelligence (AI) technology at the Malaysia-Thailand land border in enhancing border security. Based on a series of interviews with relevant ministries, enforcement agencies, technology experts, academic experts and other stakeholders, as well as secondary sources, this study found that AI technology has the potential to overcome issues pertaining to weak border control management faced by the Royal Malaysian Police (RMP), the main enforcement agency that manages the Malaysia-Thailand land border along with other enforcement agencies. Among the issues are a lack of enforcement, integrity concerns and limited manpower to control Malaysia's porous borders. However, some strategies should be taken to adapt AI to our border security system. Thus, this article analyses the concept of Integrated Border Management (IBM) to obtain coordination and cooperation among all relevant authorities and countries involved in the adaptation of AI technology at the Malaysia-Thailand land border. This article also analyses how Malaysia should respond to the ethical implications of AI technology. This study will help promote a cross-border collaboration network between Malaysia and related foreign countries in dealing with migrant smuggling issues.

Keywords: Border control; border surveillance; migrant smuggling, AI technology; Integrated Border Management; cross-border collaboration

Introduction

Due to the risk of national security threat brought by migrant smuggling activities, it is very important for a country to ensure that the border security is well managed. The Government of Malaysia's overarching policy known as the Malaysian Public Safety and Policy emphasizes on the aspect of increasing border control and surveillance in an integrated and continuous manner to prevent and counter border intrusions, including incidence of migrant smuggling. According to Wagner (2022), in the context of the European region where national borders are relatively open due to the Schengen Agreement, border management is becoming critical for each European country to choose the best functioning practices and the most modern standards to control, survey, and secure their borders. However, effective management of securing, controlling, and surveying borders is becoming more complicated and challenging, particularly when addressing transnational organized crime and terrorism activities. Additionally, the past decades saw European countries struggling to overcome the rising incidence of migrant smuggling and trafficking in persons involving irregular migrants and refugees from various countries outside of the European region (Wagner, 2022). In the wider Asia and the Southeast

Asian region in particular, existing studies indicate that the use of advanced technologies by transnational organized crimes has evolved significantly in many areas such as the use of encrypted messaging, geolocation and navigation (e.g., GPS and mapping applications), cryptocurrency and mobile payment system, and modern surveillance and monitoring tools (e.g., satellite imagery). This signals the need to reflect and examine the current border management, encompassing not only aspects of border integrity and cooperation across different enforcement agencies, but also modern technologies. Advanced and modern technologies have high potential to further improve various aspects of border management, including monitoring and surveillance, detection and identification, intelligence and data sharing, and joint operations.

Malaysia-Thailand land border is characterized by several key features, making it the most dynamic region and attractive to a range of smuggling and illegal border crossing activities. The Thailand-Malaysia land border stretches approximately about 650 kilometres, runs through diverse landscapes, including jungles and mountainous areas, making it extremely challenging for the border enforcement authority to perform surveillance. Both countries, Malaysia and Thailand have their respective border control agencies in charge of border control management. From the Malaysia side, the Malaysia-Thailand border lines governed and controlled by two main Malaysian enforcement agencies, namely the Royal Malaysian Police (RMP) through the General Operations Team (locally known as "*Pasukan Gerakan Am*" - PGA), and the Malaysian Armed Forces (locally known as "*Tentera Angkatan Malaysia*" - ATM). RMP has the powers to arrest, search, investigate, confiscate and prosecute individuals violating Malaysian immigration laws, while the ATM does not have such powers.

Existing estimates indicate as few as two to exceeding five million migrants employed in Malaysia, including undocumented migrant workers, asylum seekers and refugees, and this constitutes around 20 percent of Malaysia's labour force (see Hwok-Aun & Yu Leng, 2018; Andika & Mashitah, 2022). Most migrants originate from the neighbouring countries such as Indonesia, the Philippines, Myanmar, Vietnam and Thailand. Other nationalities include Bangladesh, India and Nepal. Existing studies also indicate that promising job opportunities and relatively better salary in Malaysia continue to attract migrants from the neighbouring countries, including those that enter Malaysia clandestinely (Hoffstaedter & Missbach, 2021). The Malaysia-Thailand border, given its strategic location and porous conditions, has become the main transit point used to enter Malaysia clandestinely. Importantly, the Malaysia-Thailand border land is not only used by Thai citizens to enter Malaysia illegally, but of other nationalities, in particular migrants from Myanmar (see Tual, 2023), Bangladesh and Vietnam (Wahab & Mashitah, 2022).

Factors contributing to this rising border intrusion problem are complex. Scholars claim that Malaysia's porous borders has largely contributed to easy intrusion of the Malaysia-Thailand border land by irregular migrants and smugglers (Noor Azmi et al., 2020), while other scholars claim that it is due to lack of border supervision and human resources to safeguard the Malaysian territories (Laura, Isabelle & Carles, 2020). Additionally, the lack of integrity and corrupt practices allow for easy border crossing, or without proper immigration checks (Nuurrianti & Ismail, 2020). Factors that contribute to border intrusion problem can potentially be overcomed by leveraging advanced technologies such as the artificial intelligence (AI). Vishwanath (2019), for instance, argues that the effective use of the AI technology can overcome issue pertaining to lack of human capacities in monitoring and safeguarding Malaysia's borders. In the meantime, Mohan and Siddharth (2016) emphasize that the use of AI technology can also strengthen the level of preparedness and response to border intrusions. Worth to highlight, however, these existing studies are preliminary in nature. Some questions regarding how the AI technology can address issues around the lack of integrity, and lack of effective coordination across various Malaysian enforcement agencies, and cross-country collaboration, just to mention a few – have remained unaddressed.

Guided by the broader concept of Integrated Border Management (IBM), this study attempts to fulfil the remaining gaps in the existing literature pertaining to the use of AI technology in border management. The overarching aim of this study is to effectively leverage the potential of AI technology in addressing weaknesses in Malaysia's border control management. In doing so, this study focuses on three levels of cooperation and coordination strategies where the AI technology can help improve border control management, namely, (i) strengthening cooperation between existing enforcement agencies; (ii) extending coordination and cooperation with wider stakeholders beyond conventional enforcement agencies at the border land (e.g.,

government agencies whose portfolio related to advanced technologies); and (iii) strengthening cross-country and cross-border cooperation, especially with Thailand counterparts. Additionally, this study also aims to contribute to addressing potential ethical implications deriving from the use of AI technology in border control management. Careless adoption of AI technology in border control management can result in misinformation and various forms of harmful consequences to people, including violation of individual's privacy rights. Hence, this study includes this aspect of ethical implication.

Literature Review

1. The Use of AI Technology for Border Control and Surveillance

AI technology enables continuous monitoring of very large areas involving tens of square miles at once and enables the tracking of all pedestrians and vehicles within the area (Kerimovs, 2024). The use of AI allows for information to be automatically extracted, including each movement of object in real time (Kerimivs, 2024). Data analysis together with real-time monitoring technology offers the ability to track migration movements as they happen (Kabir et al., 2023). Mobile applications, satellite imagery and sensor networks contribute to collection of information and data, while AI processes this data in real time, enabling fast decision-making process and resource allocation based on data patterns generated, as well as increasing the efficiency of aid and support initiatives (Kabir et al., 2023). The AI technology has high potential to transform various aspects of national security approach and strategies, comparable to nuclear weapons, aircraft, computers, and biotechnology (Muhammed & Halid, 2020). Due to the breadth of potential future applications available, border security agencies can take advantage of the use of AI technology to carry out various activities and operations whether at land, sea or air borders (Slapakova, 2021).

The United States (U.S.) has innovated the AI technology to enhance their border surveillance such as independent towers (a Watchful Eye) along the U.S–Mexico border that utilize high-precision AI technology, consisting of a combination of radars and surveillance cameras with the capability to cover an area with a diameter of 4.8km and a height of 10m (Saadi & Samir, 2024). Another example in the U.S. indicates that the National Institute of Standards and Technology has been able to prove that facial recognition software gets 20 times better in searching the database to find matching pictures (Feldsteint, 2019). This potentially be used to help improving face recognition in border control management. In China, the Chinese national police uses the high-precision AI technology to find and target ethnic Uighurs outside of Xinjiang (i.e., based on their appearance), including in affluent cities such as Hangzhou and Wenzhou, and record their movements across China. Leveraging this AI technology, the Chinese Government was able to scan and detect about 500,000 Uighurs in just one month (Kasapoglu & Kirdemir, 2019). Additionally, the Chinese Government has been leveraging the AI technology in its border control measures by developing smart surveillance system to identify suspicious or wanted individuals (Saadi & Samir, 2024). In Canada, the human-centred AI applications have been effectively leveraged to improve its immigration settlement sector (Nejadgholi et al., 2024).

2. The Prospect of AI technology in Strengthening Malaysia's Border Control Measures

In 2020, it was reported that 249 smugglers have been detained at the Malaysia-Thailand border (Sinar Harian online, 2020), and more than 100 undocumented immigrants have been detained throughout the year (Bernama, 2020). As of early 2024, Astro Awani (2024) reported that the most rat roads identified around the Malaysia-Thailand border land were in Kedah, Perlis and Kelantan (Astro Awani, 2024). While the Sinar Harian newspaper (2024) reported that there were as many as 140 illegal bases used by smugglers along the Golok River.

In Malaysia, the existing studies that review and analyse the use of AI technology in border control management is scarce. One significant study was written two years ago by Norilyani, Marina and Andika (2022), arguing that the use of AI technology in border management has the potential to strengthen detection of objects, avoid false alarms and improve the efficiency of security control at the border (also see Home Ministry, 2024). For the record, the Malaysia's Ministry of Home Affairs (MOHA) is now developing the Master Plan on National Border Control System (NBCS) to further strengthen Malaysia's border security

(Parliament, 2024). The MOHA stated that the NBCS would provide a comprehensive master plan framework through the development of integrated strategies and action plans involving various ministries, agencies, and other government bodies involved in national border control (Bernama, 2024). The strategic focus designed to strengthen NBCS will be implemented based on the five-front approach, namely the North (Kedah, Perlis, and Perak); East (Kelantan, Terengganu, and Pahang); South (Selangor, Negeri Sembilan, Melaka, and Johor); Sabah; and Sarawak (The Star, 2024).

3. Conceptual Framework

This study has adapted the concept of Integrated Border Management (IBM). The IBM was first introduced in 2002 by an international organization, namely, the International Center for Migration Policy Development' (ICMPD). The concept was introduced to help countries in the European Union (EU) to deal with the growing migration crisis in the region, making it one of the most successful border management projects, globally. The concept of IBM is becoming the foundation to addressing border crisis in different parts of the world, including in the Western Balkans, the Middle East, North Africa and Central Asia.

The concept of IBM promotes an integrated approach to border management by emphasizing the value of resource sharing, skills enhancement and stakeholders' cooperation within and across borders. This is expected to overcome known barriers and challenges facing enforcement agencies in countering border intrusions. The IBM approach can strengthen the state's ability to identify risks or threats at the early stage and manage scarce resources based on the need and urgency of the problems on the ground. It sets a foundation for border control agencies to operate in an integrated manner in response to risks and threats identified. Leveraging on the IBM concept, this study focuses on the three levels of cooperation and coordination strategies, namely, (i) strengthening cooperation between existing enforcement agencies; (ii) extending coordination and cooperation with wider stakeholders beyond conventional enforcement agencies at the border land (e.g., government agencies whose portfolio related to advanced technologies); and (iii) strengthening cross-country and cross-border cooperation. Figure 1 below depicts the three levels of coordination and cooperation strategies.

Level one relates to effective and efficient management of processes, information and resources in border management approach and agencies. The aim is to strengthen cooperation coordination and cooperation between the existing enforcement strategies. Level two concerns about efforts to strengthen coordination and cooperation not only within and between the conventional enforcement agencies but also other stakeholders, especially those with mandates and expertise on advanced technologies such as the AI technology. Level three revolves around the need to strengthen cross-country and cross-border cooperation, in particular between Malaysian enforcement agencies and their relevant counterparts from Thailand. Such cross-country and cross-border should also be extended via multilateral and regional cooperation, involving more than two countries. In short, the IBM has the potential to overcome the complex reality governing Malaysia-Thailand's porous border land and the complex dynamics of various agencies governing Malaysia's border management.
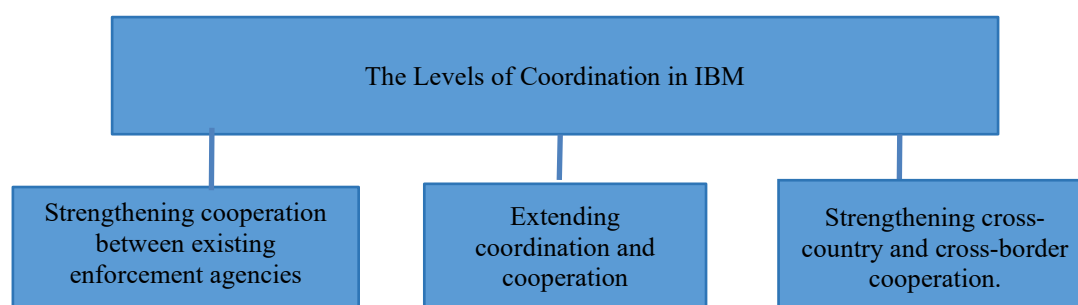

Figure 1. Three levels of coordination in IBM
Source: Adapted from the concept of IBM by International Centre for Migration Policy and Development (2002)

Figure 1 shows the intra-service cooperation which concerns the efficient management of processes, information and resources within migration and border management agencies. Inter-agency cooperation concerns the close collaboration among all national migration and border management agencies at the central level. The three priority areas for inter-agency cooperation are coordinated processing at border crossing points, integrated information technology systems, and awareness-raising and joint responsibilities. International cooperation concerns the establishment of communication and coordination channels at the local, bilateral and multilateral levels. It refers to the local cooperation between officials on both sides of the border, bilateral cooperation between neighboring states, and multinational cooperation, focusing on migration and border management issues faced by RMP such as lack of enforcement, integrity issues, and limited manpower.

Methodology

1. Research Design
This study focuses on the regulatory control zone of PGA North Brigade and PGA Southeast Brigade which covers 662km of the Malaysia-Thailand border from Batu Putih, Kedah to Bukit Kayu Hitam, Perlis and from Pasir Mas to Tumpat, Kelantan. In this study, the qualitative approach is used because it helps to understand the migrant smuggling phenomenon and the strategies in border surveillance to combat the escape of smugglers based on the experts' experience and knowledge. The qualitative method helps to understand how AI technology has the potential to overcome issues pertaining to weak border control management faced by RMP at the Malaysia-Thailand land border and help to enhance border security. According to Iskandar (2021), qualitative research produces an approach that is interpretive or constructive and critical research to understand a phenomenon in a specific context through a thinking process. The data collection in this study is from document analysis, interviews, and observation. The interview protocol was built based on document analysis i.e. literature review and government policies i.e. National Border Master Plan and the direction of the Public Safety and Order Policy (DKKA).

2. Data Collection Process
This study underwent an ethics clearance process under the auspices of the Research Ethics Committee of the National University of Malaysia (UKM) before conducting the interview session. The approval obtained was for the period from June 16, 2022 until June 15, 2024. Primary data was collected through a series of interviews with relevant stakeholders, including one official from the Internal Security and Public Order Department (KDNKA) Bukit Aman, two officials from the PGA North Brigade, two officials from the PGA Southeast Brigade, one official from the PGU Bukit Aman, two officials from the National Security Council (NSC), one official Ministry of Science, Technology and Innovation (MOSTI), and one official from MOHA. The informants were selected based on their involvement in the policy formulation process and policy implementation concerning the Malaysia-Thailand land border. These include a broad-based criterion whereby informants must have served their relevant agencies no less than five years.

Interviews were also made with academic experts, each from the University of Technology Malaysia (UTM) and the National University of Malaysia (UKM) as well as two officials from Malaysia-based Aerodyne group i.e. a DT3 (drone technology, data technology & digital transformation) enterprise solutions provider. Aerodyne was selected because it is a global leader in the fast-growing drone industry. Aerodyne was ranked first among the top 40 remote sensing companies in the world in 2021 by Drone Industry Insights, leading the global technology curve in the use of drone data and AI-powered analytics to solve complex industry challenges, enabling organizations to rapidly scale, digitally transform, operate optimally and increase productivity. The KDNKA, PGA, and PGU officials are the representatives of the RMP who have the power to arrest, seize and prosecute and can enforce all the legal acts in Malaysia (The Malaysian Armed Forces who are also in charge of controlling the land border do not have such power) and all the informants in this study were the representative of the broader stakeholder community because they involve directly with the policies and conduct the border operations. The interviews were conducted using a semi-structured interview protocol based on previous studies and document analysis. Document analysis was collected through the division of primary data and secondary data. Primary data was obtained from MOHA official government

reports such as directives and policy papers, while secondary data was from academic journals/articles/thesis and online news, namely Bernama, Berita Harian, The Star, MyMetro and Astro Awani.

3. Data Analysis

Data is based on textual and descriptive analysis. Both ate very important in this kind of study because it has an epistemic goal of knowledge and understanding (Bisschop, 2021; Oh et al., 2021).

Finding

Taking into account the compatibility aspect of technology with terrain conditions, the proposed use of AI technology at the Malaysia-Thailand land border is as follows:

1. Face Recognition Technology (FRT)

FRT is a biometric technology that uses video or still image cameras to match stored or live recordings of individuals with images from a database. AI technology enables AI algorithms to analyze massive datasets in search of anomalies, patterns, and trends that may indicate impending security threats, thereby empowering security agencies to more precisely anticipate potential threats and enhance their preparedness (Kabir, 2024).

According to MOHA officials, the use of advanced close-circuit television (CCTV) equipped with an AI FRT system could identify suspects and people who enter the restricted area (Noor Afandi, personal communication, December 15, 2023). The image acquisition system from CCTV will go through the process of image pre-processing, face detection, extraction from the obtained image and recognition. An accuracy of more than 90% has been obtained from this process, proving that AI can integrate data sets that are stored evenly or randomly and interpret and make chains between data which humans are not able to do (Noor Afandi, personal communication, December 15, 2023).

2. Intrusion Detection Technology

Intruder detection aims to identify unauthorized individuals or potential threats in protected areas (Noor Afandi, personal communication, December 15, 2023). This system is suggested for use in CCTV and must be diversified to reduce false alarms caused by animals, weather, or other non-threatening factors (Noor Afandi, personal communication, December 15, 2023). By using smart detectors combined with integrated data sets on migration patterns, crossing activities, demographics, and environmental data, AI can serve as a security agent to work with law enforcement in detecting threats at border lines that pose a high risk to individuals should they move physically (Deloitte, 2021). The system can analyze trends in large-scale travel data to better allocate security resources and provide increased situational awareness along border crossings (Noor Afandi, personal communication, December 15, 2023). The Simple Online and Real-time Tracking (SORT) algorithm is used for real-time intrusion tracking and the implemented system has been tested for video-streaming using the NVIDIA Jetson TX2 platform with 97% accuracy at an average of 30 fps (Noor Afandi, personal communication, December 15, 2023). According to MOHA officials, the use of intrusion detection video is seen to be compatible with Malaysia's porous borders (Noor Afandi, personal communication, December 15, 2023).

3. Patrol Drone Technology with Thermal Detector

According to Aerodyne, if there are smugglers outside the border line who are trying to enter the border, then drones with AI capabilities can capture images of what is happening and send the data to the data center (Arif, personal communication, March 06, 2024). The enforcers can then take immediate action and prepare for arrest and prevention operations (Arif, personal communication, March 06, 2024).

A drone pilot project integrated with AI technology at the Malaysia-Thailand land border through the collaboration of PGA and Aerodyne Group in 2020 involved flying a total of 18 missions per day for 35 minutes per mission (Arif, personal communication, March 06, 2024). The border patrol coverage was 189km per day with only two field operators (Zakaria, personal communication, March 06, 2024). In this operation, productivity was improved by 18.8x wider coverage area. A total of 11,070 flights (615 days) were conducted in Rantau Panjang, Kelantan involving Pos Rantau Panjang, Pos Ibrahim Pencen, and Pos Haiwan/Sharifah,

as well as Perlis involving Pos C6 Padang Besar (Zakaria, personal communication, March 06, 2024). The drone was operated five times a day in the proof of concept (POC) time interval with a speed of 18km per hour and a height of 60-400 meters (Zakaria, personal communication, March 06, 2024). This operation helped RMP in dealing with the limited technology functions problem at the border (PGA Official, personal communication, November 29, 2022). This operation also helped RMP to deal with surveillance challenge due to a lack of officers in a wide border (KDNKA Official, personal communication, August 16, 2022). The use of drone technology equipped with AI has proven to be able to deal with the challenges of monitoring the Malaysia-Thailand land border due to the drone's ability to make high flights by flying in remote, hilly and inland areas that are difficult for humans to do (Arif, personal communication, March 06, 2024).

Discussion
Based on the above findings, the study concludes that AI technology has the potential to overcome issues pertaining to weak border control management faced by RMP. However, the government needs to be financially sound and raise funds to roll out AI technology. The government should also collaborate with the public and private sectors to establish platforms and resources for officers to upskill themselves in AI technology. According to MOHA officials, companies in private sectors could bring with them industry-specific expertise and knowledge that can be used to curate training materials for AI-enabled technology for border surveillance (Noor Afandi, personal communication, December 15, 2023). Investing in AI research and development will ensure that this country is kept abreast of the latest developments in AI and can implement cutting-edge AI solutions for national problems faced by end users. Encouraging research related to the cybersecurity of AI, AI governance, and AI ethics is also key to ensuring that the safety and resiliency of AI systems and tools are in parallel with new use cases. This study finds that the government is ready to introduce the use of AI technology in its border surveillance. It is proven through the initiative that has been done in the NBCS feasibility research project to develop a dash board for monitoring system at the border. The government is also running the IMalaysia project study on the suitability of technology at the border.

The study on the IBM concept will help to ensure the successful adoption of this technology because it analyses some strategic cooperations to be taken by policymakers and security agencies, and extends to how Malaysia should react to the issues of bias, discrimination, and human rights in using AI technology, along with Thailand, to avoid some controversial issues such as invasion of patrol drone at Thailand's border. The IBM will also help to modernize surveillance at the borders, successfully build cooperation among EU member states and non-EU countries and make them more efficient and adequate to respond to newly identified security challenges (Wagner, 2022). Based on this concept, it is possible to implement the cooperation strategy between services, agencies and international cooperation by adapting AI technology to improve security control at the Malaysia-Thailand land border. According to Figure 1, it will be done as follows:

1. Strengthening Border Control Measures in the Malaysia-Thailand Border Land
Strategies should be done to develop an integrated and safe information system in border management by using the latest technology. According to MOHA officials, the development of a centralized information system includes an early warning system and a one-stop center for the management of intelligence information obtained from devices in the field that can be accessed and shared by each relevant agency (Noor Afandi, personal communication, December 15, 2023). According to Dr. Sophan (2023), a study on the feasibility of AI technology at the Malaysia-Thailand land border needs to be conducted particularly on human tracking and activity monitoring, drones, control robots, hot spot monitoring, early warning systems and traffic monitoring (Nawawi, personal communication, May 21, 2023). Studies of the effectiveness of technology such as drones equipped with thermal cameras need to be done to see their ability to transform patrolling and border enforcement to cover large, remote and challenging areas quickly, as well as to detect heat even in complete darkness, a critical advantage for low-light operations, thus helping with mapping and corresponding planning and approaching dangerous zones (Nawawi, personal communication, May 21, 2023). This agility ensures that border patrol agents can detect and respond immediately to potential threats (Bor, S., & Koech 2023). Advanced sensors and high-resolution cameras on drones must be able to provide accurate real-time data to detect the movement of smugglers who try to cross illegal borders (Loukinas, 2022). The use of

intrusion detection video, on the other hand, is based on research by Othmani et al. (2021) who consider the borders of Tunisia and Algeria which are mountainous and forested to be compatible with Malaysia's borders.

2. Extending Coordination and Cooperation with Wider Stakeholders

Domestic measures include the cooperation of border control operations between agencies and services, ensuring compliance with regulations and revising existing control legislation and policies, increasing the capabilities of enforcement assets and technology, strengthening national border control capacity by involving communities, and providing a legal framework - laws and regulations for the use of AI. among them is to increase cooperation in border security control operations between agencies. In order to deal with the challenges of the country's geographical position and porous border conditions, the cooperation of border security control operations between agencies needs to be increased. Taking into account the diversity of the functions of each agency, joint implementation of operations can help to increase the success of an operation (Noor Afandi, personal communication, December 15, 2023). Thus, RMP and MOHA can start a focused discussion about the implementation of AI in the field of security with MOSTI, while MOSTI should involve MOHA in all committees to strengthen the foundation of the AI ecosystem in Malaysia and set a policy for the role of AI in border security control enforcement operations. RMP can then move forward by reusing tried and tested models for various appropriate applications.

At the same time, existing legislation and security control policies at the land border need to be examined and revised so that they are appropriate and relevant (Noor Afandi, personal communication, December 15, 2023). Enforcement agency assets also need to be improved by improving digital infrastructure to enable AI to be implemented (PGU, personal communication, May 08, 2024). According to Mohd Firdaus and Shahri & Huda (2021), assets need to be improved to strengthen national border control. In an effort to improve the capacity of enforcement assets, cooperation can be made with the MOF for asset allocation and procurement. Digital infrastructure needs to be improved to enable AI to be implemented such as enabling the use of cloud computing and storage for AI and improving networks and connectivity for wider access to digital infrastructure for AI (KDNKA Official, personal communication, August 16, 2022).

3. Strengthening Cross-Country and Cross-Border Cooperation

Strategies to strengthen cooperation and international negotiations between Malaysia and neighboring countries should be done to deal with the migrant smuggling issues through the use of AI technology. International negotiations between Malaysia and Thailand particularly are important to be implemented more effectively through the Bilateral and Multilateral Agreement platform especially involving patrol drones because the operation requires bilateral understanding to avoid disputes. Perhaps, the policy on international cooperation based on commonly agreed democratic principles for responsible AI between Malaysia and Thailand can help focus on responsible AI development and trust building. The Malaysia-Thailand working group and guidelines on AI governance may lead the technical and operational implementation of AI governance action plans at the border. The working group could consist of representatives from Malaysia and Thailand who can work together to implement the recommendations in this guideline, and where appropriate, include consultation with other industry partners for their views and input. This strategy requires support from the Ministry of Foreign Affairs (MOFA) and MKN in facilitating the MOFA's successful international ties with regional countries (Lokeman, personal communication, July 14, 2022).

Next, steps to build effective partnerships abroad should be taken to expand the use of the latest technology at the border. According to MOHA officials, the main focus is to increase the sensitivity and scope of the level of accessibility, make efficient decisions, instructions and proactive responses (Noor Afandi, personal communication, December 15, 2023). In order to expand the use of the latest technology, there is also a need to create strategic benchmarks with developed countries that use AI technology at the border such as the U.S. and Canada and maybe with China as well (Noor Afandi, personal communication, December 15, 2023). International cooperation should be sustained and enhanced to benefit from AI scale development (Noor Afandi, personal communication, December 15, 2023). Cameron et al. (2021) agreed that cooperation across national boundaries can maximize the advantage of scale and exploit comparative advantages for mutual benefit.

4. Ethical Implications of Using AI in Border Security

Malaysia needs to be cautious when using AI technology since it faces the issues of bias, discrimination, and human rights. The use of FRT in security surveillance brings issues of ethical and privacy considerations (Noor Afandi, personal communication, December 15, 2023). According to Sikorski (2021), the use of AI technology has had an impact and may involve significant potential threats to personal data privacy, national security, and social and economic stability.

MOSTI has published National Guidelines on AI Governance and Ethics for Responsible and Inclusive AI which covers safe city projects, agriculture, education, and health. The Global AI Initiative in this National Guidelines on AI Governance and Ethics for Responsible and Inclusive AI has proposed several approaches to promote responsible AI governance. These include respecting national sovereignty and the law, aligning AI development with the values of peace, development, democracy, and freedom, fighting the abuse of AI, practicing responsible practices, implementing risk-based governance, ensuring privacy and security, and upholding the principles of justice and non-discrimination (Awang Lah, personal communication, June 07, 2023). The implementation of laws to govern AI in these contexts could guarantee that only accurate and safe information is delivered, thus preventing potential misinformation or other harmful consequences (Awang Lah, personal communication, June 07, 2023). This is in line with the finding made by Nejadgholi et al. (2024) who concluded that accurate and safe information could prevent potential misinformation or other harmful consequences. However, there are no specific policies yet on border security (Awang Lah, personal communication, June 14, 2024).

5. Potential Challenges for Malaysia

Although there are many advantages of using AI technology at the border, there are some challenges in its implementation. Among them are the readiness and capability of Malaysia through the allocation of training and the creation of a dashboard which requires a large allocation and the weaknesses of the AI system and technology itself. According to Dr Sophan (2023), criminals can damage the technology installed in CCTV by shooting and turning off the system through the use of anti jammers tools. Therefore, a counter measures system needs to be built in response to the attack (Nawawi, personal communication, May 28, 2024). The autonomous nature of AI technology in optimizing various processes, its ability to modify behavior without human supervision, AI-based development and operations that are also not subject to adequate risk management and administrative oversight, have caused AI-based systems to be potentially more vulnerable to damage compared to conventional software systems (Sikorski, 2021). That is why it needs minimal human supervision (Nawawi, personal communication, May 28, 2024). AI technology is also exposed to the risk of cyber attacks. Thus, for the protection of data security and cyber attacks, robust cyber security measures need to be made including encryption, system intrusion detection, regular security audits, and establishing the latest security protocols to protect against evolving threats (Siti Sabrina et al., 2024).In the absence of regulation in the AI industry, every serious risk, disadvantages, and debate needs to be carefully considered (Hossain et al., 2024).

Conclusion

To conclude, this article has elaborated three ways in which Malaysia can better leverage the AI technology in improving its border control management. These include adopting the FRT in improving facial recognition method in border monitoring and surveillance, upgrading intrusion detection technology, and introducing patron drone technology with thermal detector. To effectively use such technologies, this study proposed three levels of coordination and cooperation strategies. These include, (i) strengthening border control measures in the Malaysia-Thailand border land; (ii) extending coordination and cooperation with wider stakeholders; and (iii) strengthening cross-country and cross-border cooperation. Equally important, this study has explained how the inappropriate and careless use of AI technology in border management can result in harmful consequences to peoples, including violations of their rights. This study is of the view that the concept of IBM, if appropriately adapted, can help improve coordination and cooperation across various Malaysian enforcement agencies and other wider stakeholders locally, as well as foreign counterparts involved in border control management. Cooperation with Thailand in particular who shares the border land with Malaysia should also be

prioritized. Overall, the careful and effective use of AI technology in border management can create safer, more efficient and effective border management, benefiting nations and people amidst growing misuse of advanced technologies and complex dynamics of organized crimes.

Conflict of Interest: None of these authors has any conflict of interest.

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