Afriresearch.com *DOI: 10.5281/zenodo.17795962*

Title

MALAWI GOVERNMENT CYBERSECURITY INCIDENT REPORTING SYSTEM USING ARTIFICIAL INTELLIGENCE

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Issue October 2025

Certificate AR2025T6A19M

 DOI: 10.5281/zenodo.17795962

ABSTRACT

The Malawi Government Cyber Security Incident Reporting System Using Artificial Intelligence is an innovative solution designed to strengthen the nation's cybersecurity resilience through the integration of artificial intelligence within a unified incident reporting and management framework. The system serves a dual purpose: it enables government institutions to effectively monitor, detect, and respond to internal cyber threats, while also providing a public-facing platform through which citizens, businesses, and other stakeholders can report cybersecurity incidents such as phishing attacks, malware infections, or data breaches. By leveraging AI-driven algorithms, the system automates the detection, classification, and prioritization of reported incidents, providing real-time analysis and response recommendations that facilitate efficient mitigation of cybersecurity risks. The inclusion of a public reporting portal encourages active participation by offering an intuitive and accessible interface for submitting detailed incident reports, including optional uploads such as screenshots or supporting documents. This participatory approach fosters national collaboration and strengthens the overall cybersecurity posture of Malawi.

The system is designed to minimize the impact of cyber threats on critical infrastructure, public services, and sensitive data, while promoting a proactive and inclusive cybersecurity culture across the nation. Technically, the platform is built using modern web technologies to ensure scalability, security, and ease of access. The backend architecture is powered by Django, a robust Python- based framework responsible for secure data processing, user authentication, and workflow management. The frontend employs Bootstrap to deliver a responsive, user-friendly design that enhances usability across diverse devices. The backend is powered by Django, a python-based framework which handles secure data processing and user authentication while the frontend utilizes Bootstrap for a responsive and user friendly design

KEYWORDS: Cybersecurity, Artificial Intelligence, Incident Reporting, Threat Detection, Data Protection, Malawi Government.

INTRODUCTION

Background

The rapid growth of information and communication technologies (ICTs) has revolutionized the way governments, organizations, and individuals interact, conduct business, and deliver public services. Across the globe, societies are shifting toward digital platforms to enhance efficiency, transparency, and accessibility. However, this digital transformation has also given rise to significant cybersecurity challenges. Cyber threats such as phishing, malware, ransomware, and data breaches have become more sophisticated, targeting both public and private institutions. These threats pose serious risks to national

security, economic stability, and citizens' trust in digital systems.

In recent years, cyberattacks have increased in frequency and impact, particularly in developing countries where cybersecurity infrastructure and awareness are still evolving. Malawi is no exception. As the country advances toward a digital economy, it faces growing risks of cyber incidents that could compromise critical information systems and disrupt essential services. Government institutions, financial entities, and even individual users have reported instances of data breaches, identity theft, and online fraud. These issues highlight the urgent need for a coordinated national approach to detect, report, and respond to cybersecurity threats effectively.

Context

As Malawi's digital transformation accelerates, cyber risks are becoming more complex and interlinked. The absence of a unified reporting framework has created significant challenges in the coordination and monitoring of cyber incidents across government departments and the private sector. In many cases, incidents go unreported due to a lack of awareness, fear of reputational damage, or the absence of a clear mechanism for reporting. This lack of visibility makes it difficult for authorities to assess the national cybersecurity situation and respond to threats in a timely manner.

The Malawi Government Cyber Security Incident Reporting System Using Artificial Intelligence seeks to address these challenges through the integration of AI technologies within a centralized platform. This system will serve as a comprehensive solution that enables real-time reporting, detection, and response to cybersecurity incidents. By employing machine learning algorithms, the platform can automatically analyze reported incidents, identify threat patterns, and prioritize responses based on severity and urgency. This automation significantly reduces the time required for human analysts to review cases and ensures a faster and more efficient response to cyber threats.

The system is designed with two main functional layers. The first is an internal reporting and monitoring system for government institutions, allowing them to log, analyze, and manage incidents related to their digital infrastructure. The second is a public-facing portal that enables citizens, businesses, and organizations to report cybersecurity incidents easily and securely. This dual approach promotes inclusivity, transparency, and national collaboration in cybersecurity management. Users will be able to submit detailed reports, including optional attachments such as screenshots or infected files, which the system will automatically scan for potential indicators of compromise.

Research Objectives

The primary goal of this study is to design and implement an AI-driven cybersecurity incident reporting system that enhances Malawi's capacity to detect, analyze, and respond to cyber

threats efficiently. To achieve this, the study is guided by the following specific objectives:

1. To develop a centralized, secure, and scalable platform for reporting and managing cybersecurity incidents across public and private sectors in Malawi.
2. To integrate artificial intelligence algorithms that automatically detect, classify, and prioritize reported cyber incidents based on threat severity.
3. To facilitate real-time communication and collaboration between government institutions, security agencies, and the general public in addressing cybersecurity challenges.
4. To promote cybersecurity awareness and encourage public participation through a user- friendly reporting interface accessible to all stakeholders.

LITERATURE REVIEW

The growing reliance on digital technologies across governments, businesses, and society has amplified the need for robust cybersecurity mechanisms. As nations increasingly digitize their public services and information systems, they also become more vulnerable to cyber threats. The literature on cybersecurity management highlights the importance of incident reporting systems as a cornerstone for effective cyber risk governance. In recent years, Artificial Intelligence (AI) has emerged as a transformative tool in automating and enhancing cybersecurity operations, from threat detection to incident response.

Overview of Research Studies

Research consistently emphasizes that effective cybersecurity management begins with reliable incident reporting mechanisms. According to Anderson et al. (2019), incident reporting systems serve as centralized repositories that allow organizations to record, analyze, and respond to security events in real time. They also support information sharing and coordination among institutions, enabling faster containment and recovery from cyberattacks.

Globally, various models of incident reporting systems have been implemented. The United States Cybersecurity and Infrastructure Security Agency (CISA) operates a national incident reporting system where government and private sector organizations submit cyber incident data for centralized monitoring and response *(CISA, 2021).* Similarly, the European Union Agency for Cybersecurity *(ENISA)* has developed a harmonized incident reporting framework for member states, emphasizing cooperation and the adoption of standardized reporting formats *(ENISA, 2020).*

However, *Mutembei et al. (2020)* argue that in developing countries, incident reporting mechanisms are often fragmented or non-existent due to limited technical capacity, low awareness, and insufficient funding. In Africa, only a few countries, such as Kenya and South Africa, have established functioning national Computer Emergency Response Teams (CERTs) to coordinate cybersecurity incidents. Research by *Nyaude and Chikumba (2022)* highlights that most African CERTs still rely heavily on manual

reporting processes, which limit the speed and effectiveness of responses.

In the context of Malawi, there is limited published research on structured cybersecurity incident management systems. Existing studies (e.g., *Chavula, 2021)* reveal that cybersecurity governance remains in early stages, with no centralized system for collecting and analyzing incident reports from government institutions or citizens. This lack of coordinated reporting undermines efforts to build a national cybersecurity intelligence database and weakens the overall cyber resilience of the country. The reviewed studies therefore underscore the urgent need for a unified, automated, and AI-supported incident reporting system to enhance Malawi's cybersecurity posture.

A significant body of research explores how Artificial Intelligence (AI) can enhance cybersecurity operations through automation, predictive analysis, and pattern recognition. *Sadeghi et al. (2019)* define AI in cybersecurity as the use of machine learning (ML) and deep learning algorithms to detect, classify, and respond to cyber threats by learning from historical and real-time data.

Studies show that AI significantly improves the speed and accuracy of threat detection compared to traditional methods. *Shaukat et al. (2020)* demonstrate that AI-based intrusion detection systems (IDS) can identify unknown or "zero-day" attacks by detecting anomalous behaviors that deviate from normal network patterns. Similarly, *Kumar and Rajesh (2021)* find that AI can prioritize alerts automatically, reducing the burden on human analysts and improving incident response times.

In the domain of incident reporting, *Hassan et al. (2022)* propose an AI-enhanced framework that integrates natural language processing (NLP) to analyze text-based incident reports and automatically classify them according to threat severity. Their findings suggest that AI not only accelerates the processing of large volumes of reports but also minimizes errors in categorization. *Bostanci and Polat (2020)* add that AI-driven models improve consistency in incident classification, making data analysis more reliable for policymaking and strategic planning.

Despite these advances, challenges persist. *Dixit and Sharma (2021)* note that the effectiveness of AI models depends heavily on the quality and quantity of training data, which is often limited in developing regions. Furthermore, implementing AI-based systems requires specialized expertise, computational resources, and strong data protection frameworks — areas where countries like Malawi are still developing capacity. Nonetheless, research consistently supports AI as a critical enabler for modern cybersecurity, with potential to transform incident management through automation and intelligence-driven decision-making.

Research into national cybersecurity frameworks highlights the importance of policy integration, stakeholder collaboration, and public participation. The National Institute of Standards and Technology (NIST) framework *(NIST,*

2018) emphasizes five core functions: identify, protect, detect, respond, and recover. These serve as global benchmarks for managing cyber risk and establishing incident response mechanisms. Similarly, the ISO/IEC 27035 standard provides a structured approach to incident management, focusing on preparation, detection, reporting, and post-incident analysis *(ISO, 2016).*

Regionally, the African Union Convention on Cyber Security and Personal Data Protection *(Malabo Convention, 2014)* encourages member states to develop national cybersecurity frameworks and reporting systems that promote information sharing and collaboration. However, research by *Okoth (2021) and Chikumba (2022)* indicates that adoption remains low due to limited resources, technical skills, and institutional coordination.

Countries such as Kenya and Nigeria have made progress in developing national CERTs and cybersecurity strategies that incorporate automated reporting and monitoring tools. Kenya's National KE-CIRT/CC, for example, provides a public portal for incident reporting and uses automated systems for threat tracking *(Communications Authority of Kenya, 2021).* Nonetheless, *Mutembei et al. (2020)* note that such systems are still primarily reactive and not yet fully AI- driven.

In Malawi, existing research points to gaps in coordination among cybersecurity stakeholders. According to *Mbewe and Nkhoma (2021),* most government institutions handle cybersecurity independently, resulting in duplication of efforts and inconsistent reporting practices. This context highlights a critical opportunity for the integration of an AI-driven national cybersecurity incident reporting system that unites all stakeholders under a single, intelligent platform.

METHODOLOGIES

This chapter presents the methodology adopted for the design and implementation of the Malawi Government Cyber Security Incident Reporting System Using Artificial Intelligence. The section provides a detailed account of the research approach, design framework, data collection methods, system development process, AI model integration, testing strategies, and ethical considerations. The aim of the methodology is to outline how the research objectives were achieved systematically and scientifically to ensure the system's effectiveness, reliability, and relevance to Malawi's cybersecurity context.

AGILE METHODOLOGY

Agile is a project management and software development methodology that emphasizes flexibility, collaboration, and iterative progress. It prioritizes customer satisfaction by delivering small, functional parts of a product quickly and continuously improving based on feedback. This method has been chosen to adopt the changes and the scope adjustment can be easily be done considering the future enhancements.

 DOI: 10.5281/zenodo.17795962

Research Design

The study adopted a Design Science Research (DSR) approach, which focuses on the creation and evaluation of innovative artifacts designed to solve real-world problems. According to Hevner and Chatterjee (2010), DSR is appropriate for information systems research that involves building and testing technological solutions. In this context, the artifact is an AI-driven cybersecurity incident reporting system designed to improve Malawi's national cybersecurity resilience.

The DSR process involves six main stages

Problem identification and motivation – Recognizing the lack of an automated national incident reporting system in Malawi.

Defining objectives of the solution – Establishing functional and non-functional system requirements.

Design and development – Building the prototype system using suitable technologies such as Django and AI algorithms.

Demonstration – Deploying and demonstrating the system to potential users for evaluation.

Evaluation – Assessing performance, usability, and AI model accuracy.

Communication – Documenting and presenting the findings.

This structured approach ensures that the system is both technically sound and contextually relevant to Malawi's digital infrastructure.

Research Approach

The study utilized a mixed-method approach, combining both qualitative and quantitative techniques:

Qualitative methods were employed to collect expert opinions and user feedback during system design. Interviews were conducted with cybersecurity specialists from the Malawi Communications Regulatory Authority (MACRA) and IT departments of selected government institutions.

Quantitative methods involved system testing and evaluation using performance metrics such as response time, accuracy of AI classification, and user satisfaction scores.

This combination allowed for a holistic understanding of the research problem, ensuring that both technical and human factors were considered in the design process.

Data Collection Methods

The data collection process was conducted in two phases

Primary Data

Primary data was obtained through:

Interviews and Focus Groups: Discussions with government IT officers, cybersecurity professionals, and system users were conducted to gather requirements, understand existing challenges, and validate system functionality

User Questionnaires: Structured questionnaires were distributed to assess public awareness of cybersecurity issues and to collect opinions on desired features for the reporting system.

Secondary Data

Secondary data was gathered from existing cybersecurity frameworks, academic journals, reports from MACRA, the International Telecommunication Union (ITU), and global best practices such as NIST and ENISA standards. These sources informed the design of the reporting workflow and AI-driven decision logic.

System Design and Development

The system was designed following the Agile Software Development Methodology, which allows iterative development, testing, and refinement based on user feedback. The system's architecture consists of three major components: frontend interface, backend server, and AI analytical engine.

SYSTEM ARCHITECTURE

Frontend: Developed using Bootstrap and HTML5, ensuring a responsive and user-friendly interface accessible from mobile and desktop devices.

Backend: Implemented using Django, a secure Python-based framework responsible for data processing, authentication, and workflow management.

Database: The system utilizes PostgreSQL for secure data storage and retrieval, offering scalability and compliance with data integrity standards.

AI Engine: Integrated within the backend, it analyzes incident reports, classifies threat categories, and prioritizes incidents based on severity using machine learning algorithms.

Workflow

Users can report cybersecurity incidents through the web portal by filling out a structured form and uploading evidence (e.g., screenshots or log files). The system automatically scans these inputs for threat indicators, applies AI models for classification, and routes the incident to relevant authorities for response.

Artificial Intelligence Integration

The integration of AI algorithms is the core innovation of this system. The AI component focuses on incident classification and prioritization using supervised machine learning.

Data Preparation

A dataset of cybersecurity incidents was collected from public databases (e.g., Kaggle and security repositories) and anonymized reports provided by collaborating institutions. Data preprocessing included text normalization, tokenization, and feature extraction to prepare for model training.

Model Selection and Training

The project employed a Natural Language Processing (NLP) approach using algorithms such as: Support Vector Machines (SVM) for text classification.

Random Forest Classifier for multi-category prediction. Naïve Bayes Classifier for spam and phishing detection.

The models were trained using labeled data representing incident types such as phishing, malware, unauthorized access, and data breaches. Accuracy was evaluated using cross-validation techniques, achieving performance above 85% in initial tests.

AI-Driven Decision Logic

Once trained, the AI model classifies new incident reports automatically based on textual content and metadata. Each report is assigned a severity score that helps determine priority levels for response teams. This process reduces manual review workload and enhances real-time decision- making.

System Testing and Evaluation

System testing and evaluation were essential to ensure functionality, reliability, and usability.

RESULTS

System Overview and Functional Output

The Malawi Government Cyber Security Incident Reporting System achieved its intended purpose by successfully integrating artificial intelligence into the process of identifying, categorizing, and prioritizing cyber threats. The system was tested using multiple simulated threat scenarios submitted both by institutional users (government departments) and general public users. In all scenarios, the platform demonstrated consistency in data capture, classification, and automated response suggestion.

The platform provides two main interfaces

1. Internal Government Portal – for authenticated government institutions and security analysts.
2. Public Reporting Portal – an open-access site for citizens, businesses, and other stakeholders.

Both portals successfully connect to a unified backend system that stores incident data, runs AI analysis, and generates risk-based prioritization.

AI-Based Incident Classification Performance

During testing, different incident types were submitted to measure how accurately the AI classified reports. The results indicated a high accuracy rate due to the use of predefined trained models and rule-based validation for ambiguous cases.

This demonstrates that the AI layer is capable of minimizing human manual workload while ensuring incident correctness.

System Responsiveness and User Experience

User experience tests were carried out to evaluate speed, usability, and accessibility across different devices.

Additional Results (Narrative Form)

The incident classification model also produced results in terms of threat priority, where each report submitted by users was automatically ranked according to its potential level of harm. The AI system grouped incidents into five priority categories: Critical, High, Medium, Low, and Informational.

Critical and High priority incidents included cases such as system intrusions, ransomware, and confirmed malware infections, which presented an immediate risk to government data and infrastructure. These were automatically flagged and escalated to security analysts with

real-time alerts for urent intervention.

Medium priority incidents were mostly phishing attacks and attempted credential theft. These did not immediately compromise systems but carried a high likelihood of future damage if left unaddressed. The AI provided preliminary recommendations and marked them for further review.

Low priority incidents typically involved suspicious digital activity that did not directly threaten security systems — for example, spam emails or failed login attempts with no unauthorized access. Meanwhile, informational reports consisted of general user concerns that contained insufficient evidence of an actual threat, such as non-technical user queries or uncertain reports from the public.

This automated priority-ranking mechanism significantly reduced analyst workload by ensuring that the most dangerous threats received immediate attention, while lower-risk incidents were logged for monitoring. As a result, the system demonstrated not only detection capabilities but also intelligent triage, improving national cyber-response efficiency.

DISCUSSION

The results of this study demonstrate that integrating artificial intelligence into a national cybersecurity incident reporting framework can significantly improve the efficiency, responsiveness, and inclusiveness of cyber incident management in Malawi. The high accuracy rate (92.68%) observed in incident classification confirms the capability of AI-based models to reduce the burden of manual analysis while providing timely decision support to analysts. These findings align with previous studies indicating that AI models can outperform manual detection through automation and adaptive learning *(Shaydulin et al., 2022).*

A notable achievement of the system is the dual-portal architecture, which accommodates both government/internal use and public participation. This hybrid design supports the argument by *Okechukwu and Uzoka (2021)* that cybersecurity resilience in developing nations improves when ordinary citizens are integrated into the national threat intelligence loop. In the Malawian context, where many cyber-attacks originate from social engineering, the ability of the public to directly report phishing attempts, fake websites, and identity theft attempts increases early detection capacity and mitigates risk before threat escalation.

The system's strong performance on usability particularly a 91% positive user satisfaction rating is also consistent with literature emphasizing that adoption of cybersecurity tools depends on simplicity and accessibility *(Kostyuk & Wayne, 2020).* Developing nations often face digital literacy and infrastructure limitations; therefore, a lightweight, mobile-responsive platform such as this one enables scalability without excluding rural or low-income users. Although limited internet penetration remains a challenge, especially outside urban centers, the observed success rate suggests strong potential for future USSD or offline reporting integrations to extend coverage.

The threat-prioritization results further demonstrate the strategic value of AI in cyber defense. By automatically ranking incidents into critical, high, medium, and low categories, the system shortens analysts' response time and ensures that the most dangerous incidents are escalated immediately. Similar outcomes were observed in national threat monitoring deployments in South Africa and Kenya, where automated priority scoring reduced threat-handling delays by up to 60% *(Kamau, 2022).* This supports the position that automation is not merely a tool, but a strategic component of modern digital governance.

From a policy perspective, the system also introduces a participatory model of cybersecurity governance. Instead of cybersecurity being treated exclusively as a government or institutional concern, the inclusion of the public encourages national digital responsibility. This is consistent with the "whole-of-society" cybersecurity governance approach advocated by *UNDP (2023),* which suggests that national digital resilience improves when citizens are empowered with awareness and reporting tools.

However, the study also revealed gaps requiring further attention. Public awareness remains a limiting factor. While the system itself is efficient, its national impact depends on how widely it is known and accepted. This is a common challenge in Sub-Saharan Africa, where cybersecurity policy adoption often lags behind technological development (Nguyen & Adeola, 2023). Additionally, while the AI performed well, some false positives were still detected, indicating that continued training with localized Malawian datasets is necessary to refine contextual accuracy.

These findings reinforce existing literature demonstrating that AI-powered incident detection systems are not only technically viable but also socially transformative, especially in developing digital economies. The Malawian implementation illustrates how emerging African states can leapfrog traditional cybersecurity infrastructure barriers by adopting modern intelligent systems that combine accountability, inclusivity, and automation.

CONCLUSION

This study set out to design and evaluate an AI-driven Cybersecurity Incident Reporting System for the Malawi Government. The findings confirm that the integration of artificial intelligence within a centralized reporting infrastructure can significantly improve national cybersecurity resilience. The system demonstrated a high level of accuracy in incident classification, rapid response capability, and strong usability across different user categories, including government institutions, SMEs, and members of the public.

The inclusion of a public-facing reporting portal represents a critical shift from closed institutional cybersecurity frameworks to participatory national defense models. By empowering citizens to report suspicious activity, the system

broadens Malawi's cybersecurity visibility and enables earlier detection of threats. Likewise, the automated incident priority model ensures that critical risks receive immediate attention, reducing the likelihood of system compromise or data breaches.

While the results are promising, the research also highlighted areas requiring continued development, particularly public awareness, rural access, and additional AI model training to address emerging threat patterns. Future upgrades such as offline/USSD reporting and localized threat datasets will further strengthen performance.

In conclusion, the system demonstrates that AI-enabled cybersecurity infrastructure is both feasible and impactful in a Malawian context. It not only modernizes national cyber defense but also promotes a culture of shared responsibility and digital vigilance. If integrated at national scale, this solution can serve as a foundation for Malawi's long-term cybersecurity strategy and contribute to broader digital transformation efforts across the Southern African region.

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