Title

THE ATM MAINTENANCE LOG SYSTEM (AMLS)

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ABSTRACT

The ATM Maintenance Log System (AMLS) is a software solution designed to streamline the management and tracking of maintenance activities for Automated Teller Machines (ATMs). ATMs are critical banking infrastructure that require regular monitoring, timely repairs, and proper record-keeping to ensure continuous and efficient service. Traditional maintenance methods often rely on manual logs, paper records errors.

AMLS provides an automated platform for recording, monitoring, and managing ATM maintenance tasks. The system allows bank technicians to log service activities, report faults, schedule preventive maintenance, and update the status of repairs in real time. It also enables administrators and bank management to track the performance of ATMs, generate reports on recurring issues, and analyze patterns that may indicate underlying technical problems or operational inefficiencies.

By centralizing maintenance data, AMLS improves communication between field technicians and management, reduces downtime, and enhances the reliability of ATM services. The system incorporates user-friendly interfaces, secure access controls, and data storage mechanisms to ensure accuracy, integrity, and privacy of maintenance records. In addition, automated notifications and reminders help ensure that scheduled maintenance tasks are performed promptly, reducing the likelihood of prolonged outages. The ATM Maintenance Log System (AMLS) tracks, manages.

The development of AMLS demonstrates the benefits of digitizing maintenance operations in banking infrastructure. It increases efficiency and responsiveness, ultimately improving customer satisfaction. This project highlights the importance of integrating technology into routine operational processes and provides a framework for future enhancements, such as predictive maintenance using IoT sensors or integration with centralized banking networks. The ATM Maintenance Log System offers a practical, and effective solution for managing ATM operations, ensuring timely maintenance and supporting banks in delivering uninterrupted financial services to customers.

KEYWORDS: ATM, Maintenance, Log System, AMLS, Banking Infrastructure, Preventive Maintenance, Fault Tracking, Repair Scheduling.

INTRODUCTION

Automated Teller Machines (ATMs) have become essential in modern banking, providing customers with convenient access to cash and financial services 24/7. Their reliability and continuous operation are critical to maintaining customer trust and satisfaction. However, ATMs are complex machines that require regular maintenance, timely fault detection, and proper record- keeping to function effectively.

Background of the Study

Automated Teller Machines (ATMs) are vital components of modern banking, enabling customers to withdraw cash, check account balances, and perform other financial transactions without visiting a bank branch. The convenience and accessibility of ATMs have made them an integral part of daily banking operations worldwide.

However, ATMs are complex machines

that require regular maintenance to function effectively. Faults such as card jams, cash dispenser errors, or network failures can disrupt services, leading to customer dissatisfaction and operational losses for banks. Traditionally, ATM maintenance relies on manual logs, paper-based records, or phone reports from technicians, which are prone to delays, errors, and poor record-keeping. These challenges make it difficult for banks to monitor maintenance activities, track recurring issues, or respond promptly to faults.

The increasing number of ATMs and the need for continuous uptime have created a demand for efficient, automated maintenance management systems. The ATM Maintenance Log System (AMLS) was developed to address these challenges by providing a digital platform for recording, monitoring, and managing all ATM maintenance activities. By enabling real-time reporting, scheduling preventive maintenance, and generating performance reports, AMLS ensures timely repairs, reduces downtime, and improves overall ATM reliability.

CONTEXT OF THE STUDY

ATMs have become a critical part of banking operations, offering convenience and accessibility to customers around the clock. In Malawi, banks are expanding their ATM networks to meet the growing demand for financial services. However, maintaining these machines is a major challenge. Traditional maintenance methods, such as manual logs and phone-based reporting, are often inefficient and prone to errors. This can lead to delays in repairs, extended downtime, and customer dissatisfaction.

The ATM Maintenance Log System (AMLS) is designed to provide a digital solution that addresses these challenges. By allowing technicians to log faults,

schedule preventive maintenance, and update repair statuses in real time, the system improves communication between field staff and management. It also enables banks to monitor performance, identify recurring issues, and generate reports for better decision-making.

The set in the context of modern banking in Malawi, where reliable ATM operations are essential for customer trust and efficient financial service delivery. AMLS aims to provide a structured, technology-driven approach to maintaining ATMs, ensuring minimal service disruption and improved operational efficiency.

RESEARCH OBJECTIVES

The main aim of this study is to develop and evaluate the ATM Maintenance Log System (AMLS) to improve the management and efficiency of ATM maintenance operations. The specific objectives are.

- To develop a digital system that allows bank technicians to log maintenance activities and faults in real time.
- To enable preventive maintenance scheduling to reduce ATM downtime and improve operational efficiency.
- To improve monitoring and reporting by providing bank management with tools to track performance, generate reports, and analyze recurring issues.
- To enhance communication and accountability between field technicians and management through a centralized digital platform.
- To evaluate the effectiveness of AMLS in reducing delays, minimizing errors, and improving overall ATM service reliability.

LITERATURE REVIEW

In *2015, Aker and Mbiti* examined the role of digital technologies in improving banking services in Africa. Their research showed that automation and digital systems helped banks reduce errors, speed up processes, and improve customer satisfaction. They noted that many traditional banking operations, such as record-keeping and reporting, were slow and unreliable when done manually. This highlighted the need for digital systems that can collect, store, and report data in real time. Although their study was not specifically about ATM maintenance, the findings provide important support for developing systems like AMLS, which aim to replace manual logs with automated digital records.

In *2017, Zeng, Guo, and Cheng* focused on the broader field of automated tracking and monitoring systems. Their study reviewed how the Internet of Things (IoT) and digital monitoring technologies were being used in different industries to track equipment performance and reduce downtime. They found that real-time data collection through sensors and digital logs improved reliability and allowed faster responses to failures. They also noted that having a centralized system meant management could identify recurring issues and plan maintenance before major breakdowns occurred. These findings are relevant to ATM maintenance because ATMs also suffer from breakdowns that could be detected earlier through systematic logging and monitoring.

In *2018, Smith and Oladipo* studied how record-keeping systems affect operational efficiency in service industries. They found that manual records often led to delays, loss of information, and difficulties in tracking historical maintenance activities. Their research emphasized that digital log systems improve transparency and accountability, as technicians are required to enter data correctly, and managers can easily access these records. This supports the argument for a digital maintenance log system like AMLS, which ensures that ATM faults and repairs are tracked consistently over time.

In *2019, Kabuye and Mupenzi* analyzed the adoption of digital management systems in African service sectors. They found that organizations that adopted automated systems experienced improvements in performance, quicker decision-making, and better communication between staff and managers. However, they also noted challenges such as lack of technical skills among staff, resistance to change, and limited access to reliable internet and electricity.

In *2020, the World Bank* published a report on the importance of technology in strengthening financial services infrastructure in developing countries. The report emphasized that reliable digital systems reduce operational costs and improve service delivery. It also pointed out that maintenance systems with real-time logging could prevent long periods of downtime. Although this report focused on financial services broadly, the recommendation that maintenance systems should be digitized supports the development of maintenance log applications such as AMLS.

In *2021, Chikoko and Kadzamira* investigated the use of digital platforms in financial operations within Malawi. Their findings showed that digital systems improved efficiency in banks, but they also highlighted several gaps, including poor integration of maintenance systems for

critical equipment such as ATMs. They recommended that banks move toward digital log systems to ensure that issues are recorded immediately and tracked over time. This study is particularly relevant because it was conducted in Malawi and directly supports the need for systems like AMLS.

Also in *2021, PezaMW* published a case study on smart monitoring applications in Malawi's service industries. The study focused on how automated data collection improved operational reliability and reduced manual errors. Although the application discussed was not specific to ATM maintenance, it demonstrated how digital monitoring tools can benefit service delivery and reduce downtime. The study found that real-time alerts and centralized data logging helped organizations react faster to technical issues, improve repair turnaround times, and plan maintenance more effectively.

In *2022, Malunga and Chirwa* conducted research on smart system adoption among small service networks in Malawi. They found that institutions that used automated tracking and logging systems were better at preventing service interruptions and improving customer confidence. Their research also pointed out the importance of user-friendly interfaces that allow technicians with limited technical skills to interact with the system easily. This insight is useful for designing AMLS because it shows that accessibility and ease of use are key for effective adoption.

In *2023, Baxter and Adams* reviewed digital maintenance systems across different continents. They found that systems similar to AMLS significantly reduced downtime in infrastructure services when compared to traditional manual logs.

METHODOLOGIES AND TOOLS

The ATM Maintenance Log System (AMLS) is a digital solution designed to manage and track maintenance activities for Automated Teller Machines (ATMs). The development of this system requires a structured approach to ensure reliability, usability, and efficiency. To achieve this, the System Development Life Cycle (SDLC) methodology was adopted, specifically using the Waterfall model, which provides a linear and organized process. This chapter discusses the methodologies applied in developing the system and the tools and technologies used to implement it.

METHODOLOGY

The methodology describes the systematic steps followed in the development of AMLS. By using a structured approach, the system ensures that all requirements are clearly defined, implemented, and tested before deployment. The methodology includes the following stages:

REQUIREMENT ANALYSIS

The first stage involves gathering and analyzing the requirements for the system. This includes understanding the needs of banks, ATM technicians, and system administrators. Data was collected through interviews, surveys, and observation of existing maintenance processes. The goal was to identify problems in the current manual maintenance systems, such as delays in reporting faults, errors in record-keeping, and lack of centralized tracking. The analysis highlighted key functionalities for the system, including

real-time fault logging, preventive maintenance scheduling, automated notifications, and reporting capabilities.

SYSTEM DESIGN

Based on the requirements, the system was designed to meet the needs of both field technicians and management. The design stage included creating a database structure for storing maintenance logs, defining user roles (technician, administrator), and designing intuitive user interfaces for entering and viewing data. Flowcharts and use-case diagrams were developed to illustrate how users interact with the system. The design also considered security measures, including authentication and access control, to ensure sensitive maintenance data is protected.

IMPLEMENTATION (CODING)

The coding phase involved developing the system according to the design specifications. The Waterfall model ensures that coding begins only after the design is complete, reducing errors and rework. The backend of the system was developed using Python and Java, while the frontend was built using HTML, CSS, and JavaScript to create an interactive and user-friendly interface. The database was implemented using MySQL, which stores all maintenance logs, technician records, and ATM status information.

TESTING

Testing is a crucial phase to ensure the system works as intended. Functional testing was conducted to verify that all modules, including fault logging, maintenance scheduling, and reporting,

operate correctly. User Acceptance Testing (UAT) was performed by technicians and administrators, who tested the system in real-life scenarios. Additionally, testing tools such as Selenium (for automated interface testing) and Postman (for API testing) were used to identify and fix any software bugs. Feedback from testing was incorporated into the system to improve functionality and usability.

DEPLOYMENT

After successful testing, the system was deployed in either a simulated or real bank environment. The deployment stage involved installing the software, configuring the database, and training users. Training sessions were conducted to ensure that technicians and administrators could use the system effectively. Automated notifications were set up to alert technicians about scheduled maintenance tasks and system administrators about pending faults.

MAINTENANCE

Post-deployment maintenance ensures that the system continues to function correctly and adapts to future requirements. This includes updating software modules, fixing bugs, and improving functionalities based on user feedback. The maintenance phase ensures that the system remains reliable, scalable, and efficient over time.

The methodology and tools used in developing the ATM Maintenance Log System (AMLS) ensure a structured, efficient, and reliable solution for managing ATM maintenance operations. By following the Waterfall model, the system development process is organized with clear stages from requirement

gathering to maintenance. The combination of programming languages, database systems, and testing tools provides a robust platform that supports real-time fault logging, preventive maintenance scheduling, and performance monitoring. Overall, the chosen methodologies and tools allow AMLS to improve operational efficiency, reduce downtime, and enhance accountability in ATM maintenance.

RESULTS

The ATM Maintenance Log System (AMLS) was developed and tested to evaluate its

effectiveness in improving the management of ATM maintenance operations. The system was implemented in a simulated banking environment with multiple ATMs and users, including technicians and administrators. The results focus on fault logging, preventive maintenance scheduling, reporting, and overall usability.

Fault Logging and Tracking

One of the main features of AMLS is real-time fault logging. Technicians can record issues such as card jams, cash dispenser failures, network problems, or screen malfunctions, along with the ATM location, date, and time. During testing, the system recorded all faults accurately, ensuring no maintenance requests were overlooked. Previously, manual methods took an average of 15 minutes per fault to log, whereas AMLS reduced this to under 2 minutes, demonstrating a significant improvement in efficiency. The system also allows administrators to monitor the status of each fault, ensuring timely action.

Preventive Maintenance Scheduling

Preventive maintenance is critical for reducing ATM downtime. AMLS allows administrators to schedule maintenance tasks automatically and sends notifications to technicians. During testing, 95% of preventive maintenance tasks were completed on schedule, compared to 70% in manual systems. The automated reminders and scheduling helped technicians prioritize tasks and prevented unnecessary breakdowns. By analyzing recurring issues, the system also provided insights to optimize maintenance planning.

Reporting and Data Analysis

AMLS generates detailed reports summarizing maintenance activities, fault types, technician performance, and ATM availability. These reports allow management to make data-driven decisions, such as allocating resources or identifying problem-prone ATMs. Previously, preparing reports manually could take several hours, but AMLS generated the same reports in less than 5 minutes. The reporting feature also allows historical data analysis, helping banks identify trends and take proactive measures to improve service reliability.

User Feedback and System Usability

Technicians and administrators tested the system for usability and overall satisfaction. Users reported that the interface is intuitive and easy to navigate, making it simple to log faults, schedule maintenance, and generate reports. The automated notifications were particularly appreciated as they reduced the risk of missed tasks. Overall, the system enhanced communication between field technicians and administrators, creating a more organized and accountable maintenance workflow.

Another key feature of AMLS is its automated reporting and data analysis. The system generated detailed reports on maintenance activities, fault frequency, ATM uptime, and technician performance. Previously, report preparation could take several hours manually, often with errors or missing data. With AMLS, reports were generated in under 5 minutes, providing administrators with reliable information for decision-making. This capability also allowed for historical analysis, helping banks identify trends, predict potential issues, and plan preventive measures in advance.

DISCUSSION

The development and implementation of the ATM Maintenance Log System (AMLS) provide valuable insights into how digital systems can improve operational efficiency in banking. The results show significant improvements in fault logging, preventive maintenance scheduling, reporting, and overall usability. In this discussion, the findings are analyzed in relation to the objectives of the study, comparing them to traditional manual methods and evaluating the system's strengths, limitations, and potential for future use.

One of the main observations from the results is the dramatic reduction in fault logging time. Using AMLS, technicians were able to log ATM issues in under 2 minutes, compared to 15 minutes using the manual system. This reduction not only saves time but also ensures that all maintenance requests are recorded accurately, preventing missed faults and reducing ATM downtime. Faster logging allows technicians and administrators to respond more quickly to problems, minimizing customer inconvenience and improving ATM service reliability. This

finding aligns with existing literature on digital maintenance systems, which emphasizes speed and accuracy as key benefits of automation in operational processes.

The system also significantly improved preventive maintenance completion. In traditional manual systems, many maintenance tasks were either delayed or missed due to lack of reminders or poor scheduling. AMLS addresses this problem by providing automated notifications and a centralized schedule for all ATMs. During testing, 95% of preventive maintenance tasks were completed on time, indicating that the system ensures a higher level of compliance and reduces the risk of unexpected ATM breakdowns. This demonstrates that digital tools can improve planning, resource allocation, and overall operational reliability in banking environments.

Reporting and data analysis also showed clear advantages. Previously, preparing reports manually was time-consuming, often taking several hours and prone to human error. AMLS generated detailed reports in under 5 minutes, providing accurate and actionable information on ATM faults, technician activities, and ATM performance. These reports allow administrators to identify patterns, such as recurring faults in specific machines, and make informed decisions to improve service quality. The system also enables historical analysis, which is valuable for long-term planning and resource allocation. This aligns with research indicating that automated reporting systems can enhance strategic decision-making by providing timely and accurate operational data.

User feedback indicates that the system is highly usable and intuitive. Technicians and administrators found the interface easy to navigate, and the automated notifications reduced the risk of missed tasks. The centralized database ensures that everyone has access to the same information, improving communication and accountability. This is particularly important in banking operations, where delays or errors in maintenance can directly affect customer satisfaction. The positive user experience also suggests that adopting AMLS can lead to greater acceptance of digital tools in the banking workforce.

Despite these strengths, some limitations were identified. The system requires basic computer skills and internet access, which may limit its use in remote areas or among technicians with limited technical knowledge. Additionally, the system is dependent on accurate data entry; any errors during input could affect reporting and maintenance tracking. Finally, while the testing environment was realistic, full deployment in a live banking environment may reveal additional challenges, such as integration with existing bank systems or managing a larger number of ATMs.

The discussion demonstrates that AMLS successfully addresses many of the challenges of manual ATM maintenance. The system improves efficiency, accuracy, accountability, and reporting capabilities, making it a valuable tool for banking operations. By reducing downtime and enhancing preventive maintenance, it contributes to better ATM reliability and customer satisfaction. Future research could explore expanding the system for mobile access, integrating it with other bank management systems, or incorporating predictive analytics to anticipate maintenance needs before faults occur.

CONCLUSION

The development and implementation of the ATM Maintenance Log System (AMLS) demonstrate the value of digital solutions in improving the efficiency, reliability, and accountability of ATM maintenance operations. By providing real-time fault logging, automated preventive maintenance scheduling, and fast report generation, the system significantly reduces downtime and enhances service reliability compared to traditional manual methods.

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