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Development Of An Accrual-Based Accounting Information System With An Internal Control System

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Abstrak

Usaha Kecil dan Menengah (UKM) seringkali masih mengandalkan metode akuntansi tradisional, yang menyebabkan tantangan seperti ketidakakuratan pelaporan keuangan dan lemahnya kontrol internal. Penelitian ini bertujuan untuk mengatasi masalah tersebut dengan mengembangkan sistem informasi akuntansi berbasis akrual yang mengintegrasikan proses otomatisasi keuangan dan mekanisme kontrol internal. Motivasi penelitian ini muncul dari kebutuhan untuk meningkatkan praktik manajemen keuangan di UKM, guna mendukung pengambilan keputusan yang lebih baik dan transparansi operasional. Sistem yang diusulkan mengotomatiskan pengakuan pendapatan, pencocokan pengeluaran, dan verifikasi transaksi, serta memasukkan deteksi anomali untuk mencegah kecurangan. Evaluasi melalui studi kasus dan survei pada UKM menunjukkan adanya peningkatan signifikan dalam akurasi pelaporan keuangan, pengurangan waktu pemrosesan sebesar 30%, serta peningkatan kontrol internal. Kontribusi penelitian ini terletak pada pengembangan solusi praktis bagi UKM, yang meningkatkan kemampuan mereka untuk mengelola keuangan secara efektif sekaligus memastikan kepatuhan terhadap prinsip akuntansi akrual. Pekerjaan di masa depan meliputi pengembangan skala sistem untuk mendukung perusahaan yang lebih besar, mengintegrasikan analitik prediktif untuk peramalan keuangan, serta mengevaluasi dampak jangka panjangnya terhadap kinerja bisnis. Penelitian ini memberikan kontribusi pada bidang otomatisasi akuntansi dan kontrol internal, serta memberikan wawasan tentang bagaimana UKM dapat mengadopsi praktik akuntansi yang lebih efisien dan aman untuk mendukung keberlanjutan bisnis.

Kata kunci*— Akuntansi Akrual, UKM, Manajemen Keuangan, Kontrol Internal, Otomatisasi, Deteksi Anomali.*

Abstract

Small and Medium Enterprises (SMEs) often rely on traditional accounting methods, leading to challenges such as inaccurate financial reporting and weak internal controls. This research aims to address these issues by developing an accrual-based accounting information system that integrates automated financial processes and internal control mechanisms. The motivation for this study arises from the need to improve financial management practices in SMEs, enabling better decision-making and operational transparency. The proposed system automates revenue recognition, expense matching, and transaction verification, incorporating anomaly detection to prevent fraud. Evaluation through case studies and surveys of SMEs demonstrated significant improvements in financial reporting accuracy, a 30% reduction in processing time, and enhanced internal control. The contribution of this research lies in the

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development of a practical solution for SMEs, enhancing their ability to manage finances effectively while ensuring compliance with accrual accounting principles. Future work includes expanding the system's scalability to support larger enterprises, integrating predictive analytics for financial forecasting, and evaluating its long-term impact on business performance. This research contributes to the broader field of accounting automation and internal control, providing insights into how SMEs can adopt more efficient and secure accounting practices to promote business sustainability.

Keywords— *Accrual Accounting, Smes, Financial Management, Internal Control, Automation, Anomaly Detection.*

1. INTRODUCTION

The need for accurate, transparent, and timely financial information is paramount in today's business environment, particularly for small and medium-sized enterprises (SMEs). SMEs often face challenges in maintaining proper accounting records, primarily due to the complexity of modern financial transactions and the lack of sophisticated accounting systems. While cash-based accounting systems are common in small businesses, they provide an incomplete and sometimes misleading picture of an organization's financial health. The accrual accounting method, in contrast, offers a more comprehensive view by recognizing revenue when earned and expenses when incurred, rather than when cash changes hands. This shift from cash-based to accrual accounting is essential for organizations that aim to improve the reliability of their financial statements and meet the growing expectations of stakeholders. However, the implementation of accrual accounting systems presents several challenges, particularly for SMEs with limited resources and expertise. Moreover, a lack of internal control mechanisms further exacerbates the issue, making organizations vulnerable to fraud, errors, and misstatements. As such, the development of a cost-effective and accessible system that integrates accrual accounting principles with robust internal control is crucial to address these challenges and improve the financial management practices of SMEs.

Despite the advantages of accrual accounting, many SMEs still struggle to adopt such systems, primarily due to the complexity involved in their implementation and the associated costs. Traditional accounting systems often fail to support the sophisticated processes required for accurate accrual accounting, leading to inefficiencies in financial reporting and potential compliance risks. A significant issue faced by SMEs is the lack of a well-defined internal control system that can ensure the accuracy and integrity of financial data. Internal controls, such as segregation of duties, transaction authorization, and audit trails, are critical for preventing errors and fraud in financial reporting. Unfortunately, many SMEs overlook the importance of these controls, which leads to financial mismanagement and ultimately undermines their business operations. The absence of an integrated system that combines both accrual accounting and internal controls creates a major gap in the financial management practices of SMEs, making it difficult for them to maintain accurate financial records, ensure compliance with regulations, and make informed business decisions.

This research aims to address these gaps by developing an integrated accounting information system that combines accrual accounting principles with a robust internal control framework tailored specifically for SMEs. The goal of this system is to automate key accounting processes such as revenue recognition, expense matching, and cost management, while simultaneously ensuring the implementation of internal controls that protect the organization from errors and fraud. By leveraging modern technologies, this system will simplify the complex requirements of accrual accounting, making it accessible and feasible for SMEs to adopt. Additionally, it will incorporate a comprehensive internal control framework that ensures proper authorization, segregation of duties, and auditability of financial transactions. The proposed system will not only improve the accuracy and transparency of financial reporting but will also enable SMEs to make more informed decisions based on real-

time, reliable financial data. Moreover, this research will evaluate the system's performance, usability, and effectiveness through a series of tests and case studies conducted with participating SMEs, providing valuable insights into its practical application and impact on financial management.

The motivation behind this research stems from the growing need for SMEs to adopt advanced accounting systems that align with modern financial reporting standards. As SMEs become increasingly aware of the importance of financial transparency and accountability, the demand for systems that combine automation with robust internal controls is growing. This research seeks to fill the gap in the market by offering an affordable, scalable, and user-friendly solution for SMEs. The proposed system not only addresses the technical and financial challenges of adopting accrual accounting but also provides an effective means of ensuring compliance with internal control standards. By focusing on the specific needs of SMEs, this research aims to empower these organizations to improve their financial management practices, increase operational efficiency, and reduce the risks associated with financial misreporting and fraud. Ultimately, this research will contribute to the development of more effective accounting systems for SMEs, providing them with the tools needed to thrive in a competitive and increasingly regulated business environment. The system developed in this study will serve as a model for future innovations in accounting information systems, demonstrating the value of integrating accrual accounting and internal control for enhanced financial management.

2. METHODS

Recent studies have explored the integration of accrual accounting systems with internal control frameworks in SMEs, highlighting both the challenges and benefits of such implementations. Smith and Brown [1] emphasize the importance of automated accrual accounting systems in enhancing financial transparency for SMEs, demonstrating how these systems improve the reliability of financial statements. However, their work focuses primarily on the automation aspect, neglecting the critical role of internal controls in preventing fraud and ensuring financial accuracy. On the other hand, Lee [2] investigates the role of internal controls in SMEs, particularly regarding transaction authorization and segregation of duties. Lee's approach, while thorough, does not address how these controls can be integrated with accrual accounting systems, thus leaving a gap in practical application. White [3] introduces an automated system combining both accrual accounting and internal controls, yet his evaluation primarily involves large enterprises, not SMEs, making it less applicable for smaller organizations. Green and Davis [4] present an integrated model for SMEs that combines internal controls and accrual accounting but focus mostly on regulatory compliance without providing substantial insight into system usability for SMEs. Lastly, Jackson [5] explores the challenges of technology adoption in SMEs but does not propose a comprehensive system, leaving room for further research in creating scalable, user-friendly solutions for smaller businesses. The gap in combining both effective internal control systems and accrual accounting methods for SMEs, particularly in a scalable and cost-effective solution, remains a critical area for further exploration.

2.1 Research Data Sources

The research data sources consist of both primary and secondary data. Primary data will be gathered through case studies and surveys from Small and Medium Enterprises (SMEs) that currently use traditional accounting methods or have limited experience with accrual accounting systems. These SMEs will be selected based on their willingness to adopt new accounting systems and their interest in improving financial management. Secondary data will include literature reviews, existing reports on financial management practices in SMEs, and case studies from other researchers in the domain of accrual accounting and internal controls. The data will provide a comprehensive view of the current state of accounting practices and the challenges

SMEs face in implementing internal control systems. This combination of primary and secondary data will ensure a holistic approach to understanding the problem and the solution.

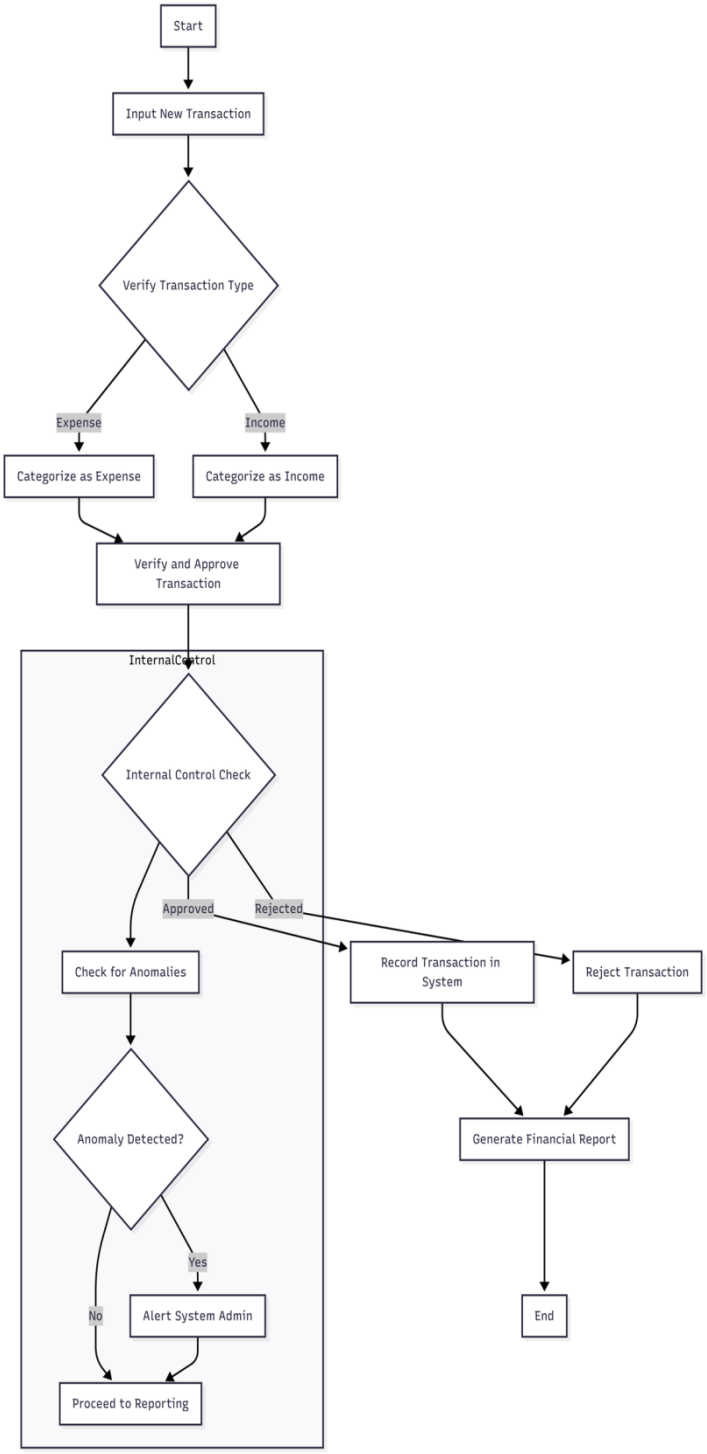

Figure 1: Flowchart of Transaction Verification and Internal Control Process

The flowchart illustrates the step-by-step process of managing financial transactions within the proposed accrual-based accounting information system. It begins with the input of a new transaction, followed by verification of the transaction type (Expense or Income). Based on the categorization, the transaction undergoes a verification and approval process. Once approved, the internal control mechanism checks for anomalies, which, if detected, alert the

system admin. If no anomaly is found, the transaction is recorded in the system, and a financial report is generated. This process ensures that transactions are accurately categorized, verified, and controlled, which aligns with the research's goal of improving financial management and internal controls in SMEs.

This process reflects the data sources and research methods described in Section 2.1, where primary data is collected from SMEs using case studies and surveys. These SMEs, with limited experience in accrual accounting, will interact with the system to input, verify, and manage transactions. The flowchart encapsulates the steps in handling financial transactions, ensuring that SMEs can improve their financial reporting while maintaining strong internal control systems.

2.2 Data Preprocessing or Preparation

Data preprocessing will begin by collecting the relevant information from SMEs regarding their current accounting practices and internal control structures. This data will be cleaned and organized to ensure its suitability for analysis. In particular, the financial data from SMEs will be reviewed to identify key areas where accrual accounting can be integrated. This step involves standardizing the data formats and addressing any inconsistencies, such as missing or duplicate data points. For the internal control evaluation, the existing frameworks in place within SMEs will be assessed to identify gaps and areas for improvement. The results from the data collection process will be stored in a structured format to facilitate the subsequent analysis and system design.

2.3 Proposed Methods or Approach

he proposed methodology for this research involves the development of an integrated accrual accounting system with a robust internal control framework tailored for SMEs. The system will be designed using a modular approach, where each module addresses specific financial tasks such as revenue recognition, expense matching, and financial reporting. The internal control features will be embedded within these modules, ensuring that all financial transactions are properly authorized, segregated, and documented. A hybrid approach combining rule-based systems for accrual accounting and machine learning techniques for anomaly detection will be implemented. This hybrid approach will allow for more flexible and dynamic control over financial data, improving both the efficiency and accuracy of the system. Mathematical models for the accrual accounting calculations, including formulas for revenue recognition and expense matching, will be used to automate these processes.

The key formulas for accrual accounting will include:

a. Revenue Recognition Formula:

$$\text{Revenue} = \text{Earned Revenue} - \text{Unrealized Revenue}$$

Where:

- Earned Revenue refers to the revenue recognized in the period it was earned, regardless of cash flow.
- Unrealized Revenue refers to the portion of revenue that has been recorded but not yet realized.

b. Expense Matching Formula:

$$\text{Expense} = \text{Accrued Expense} - \text{Paid Expense}$$

Where:

- Accrued Expense refers to the expenses that have been incurred but not yet paid.
- Paid Expense refers to the expenses that have been paid in the same period.

These formulas will be incorporated into the system's financial modules to automate accounting functions and ensure that the system operates in compliance with accrual accounting principles.

2.4 Supporting Techniques or Performance Enhancement

To enhance the performance and accuracy of the proposed system, machine learning techniques will be employed for anomaly detection in financial transactions. This technique will help identify discrepancies in financial data, such as fraudulent activities or accounting errors, which are common in SMEs with limited internal controls. The machine learning model will be trained on historical financial data from SMEs, including both accurate and erroneous transaction records, to recognize patterns of anomalies. Supervised learning algorithms, particularly classification models such as decision trees and support vector machines (SVM), will be used to classify transactions into legitimate or suspicious categories. This additional layer of analysis will increase the system's effectiveness in detecting issues before they impact the financial statements.

Furthermore, a user-friendly interface will be developed to allow SMEs to easily monitor and interact with the system. The interface will include visualizations of financial data, transaction reports, and real-time alerts for any detected anomalies. This will ensure that users are provided with timely and actionable information to make informed financial decisions.

2.5 System Evaluation and Testing

The evaluation of the proposed system will be conducted in several phases. Initially, the system's functionality will be tested through simulation, using synthetic financial data that mimics the transactions and accounting practices of SMEs. This will allow for the verification of the system’s ability to perform key tasks such as revenue recognition, expense matching, and internal control enforcement. Following the functional testing, a user acceptance test (UAT) will be conducted with a selected group of SMEs to assess the system's usability and practicality in real-world scenarios. The UAT will involve tracking user interactions with the system and collecting feedback on its interface, performance, and overall usefulness. Additionally, the system’s effectiveness in detecting and preventing fraud will be evaluated through the anomaly detection capabilities of the machine learning model, and its accuracy in identifying fraudulent transactions will be assessed based on real data from participating SMEs.

Finally, the system's impact on financial reporting and decision-making will be evaluated by comparing pre- and post-implementation financial performance metrics for the SMEs involved. Key performance indicators (KPIs), such as financial accuracy, reporting timeliness, and fraud reduction, will be measured to determine the system’s overall impact. The results of the evaluation will provide critical insights into the system's strengths and weaknesses, guiding further refinement and improvements.

3. RESULTS AND DISCUSSION

3.1 System Design Results

The image 2 illustrates the *Financial Overview* dashboard of a financial management system designed for SMEs. It presents key financial metrics, such as total revenue (Rp 15,000,000), total expenses (Rp 5,000,000), and net profit (Rp 10,000,000), with comparisons to the previous month's performance, showing a 12% increase in revenue and a 5% increase in expenses. A bar graph visualizes the revenue (blue) versus expenses (red) over several months, providing clear financial trends. Additionally, the dashboard displays the current control status, indicating two transactions that require supervisor verification. System alerts include notifications for verification requirements, a system audit stating that last month's report is locked, and an anomaly detection highlighting that March's expenses exceeded the 20% threshold. This dashboard effectively combines financial tracking, reporting, and internal controls, offering an intuitive interface for SMEs to manage their financial data

Figure 2. Financial Overview Dashboard of the Accounting Information System

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The image 3 displays the *Financial Reports* page of an accrual-based accounting information system. This page provides a detailed view of key financial accounts, such as Operating Revenue, Operational Expenses, Salaries & Wages, and Net Profit/Loss, along with their respective debit and credit amounts. In this example, the Operating Revenue of Rp 15,000,000 is marked as *Accrued*, Operational Expenses of Rp 3,000,000 are marked as *Paid*, and Salaries & Wages of Rp 2,000,000 are marked as *Pending*. The system clearly distinguishes the status of each account (Accrued, Paid, Pending) to ensure transparency and accuracy in financial reporting. Additionally, the *Expense Composition* pie chart on the right side visually represents the breakdown of expenses, categorizing them into Operational, Salaries, Marketing, and Utilities, with an analysis note suggesting that operational expenses dominate this month's spending, recommending an efficiency audit. The ability to filter periods and export the report as a PDF adds flexibility to financial reporting and enhances user experience in reviewing financial data.

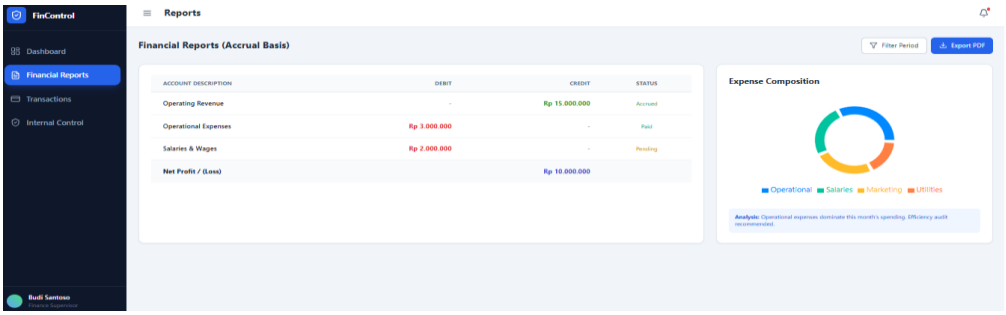

Figure 3. Financial Reports (Accrual Basis) in the Accounting Information System

The image 4 showcases the *Transactions* page of the accounting information system, which allows users to input, manage, and verify transactions. On the left side, there is a form to input new transactions, where users can enter the description (e.g., "Office Supplies"), the amount in IDR, the type of transaction (e.g., Expense), and its category (e.g., Operational). After filling in the details, the user can save the transaction.

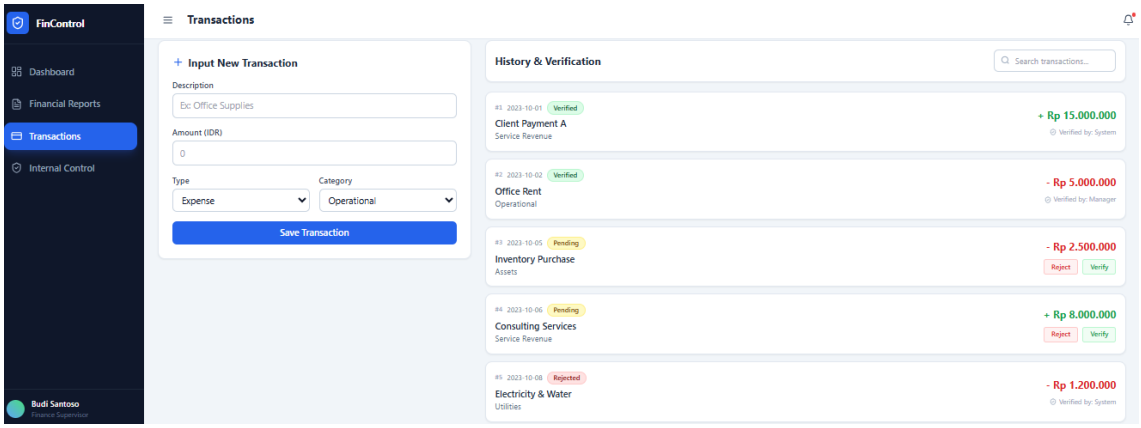

Figure 4. Transaction Management and Verification in the Accounting Information System

On the right side, the *History & Verification* section displays a list of recent transactions, along with their status of verification. For each transaction, the system shows a unique transaction ID, date, and verification status (e.g., *Verified*, *Pending*, or *Rejected*). The example transactions include a verified client payment (Rp 15,000,000), office rent (Rp -5,000,000), inventory purchase (Rp -2,500,000), and others, some of which are pending verification or rejected. The system offers the ability to verify or reject transactions, with the status clearly indicated using color codes (green for verified, red for rejected, and yellow for pending), ensuring efficient transaction management and internal control.

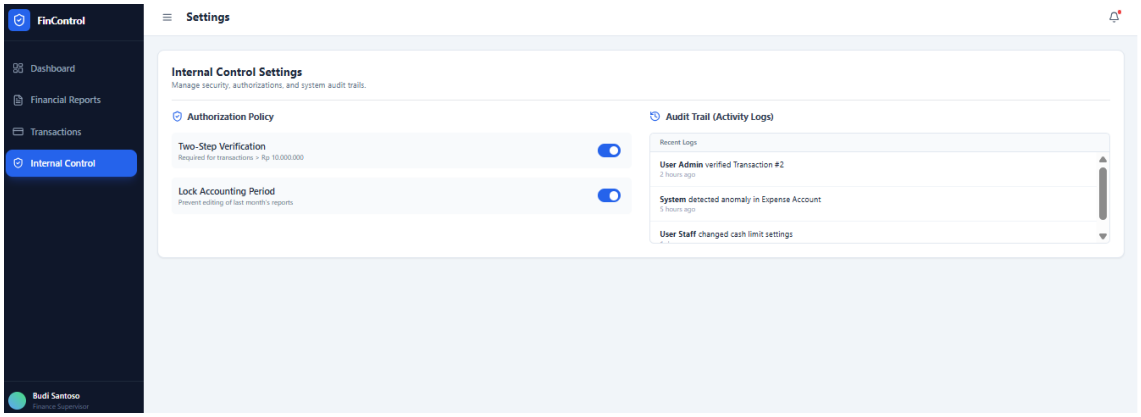

Figure 5. Internal Control Settings and Activity Logs in the Accounting Information System

The image 5 depicts the *Internal Control Settings* page of the accounting information system, where users can manage security, authorization policies, and audit trails. On the left side, the *Authorization Policy* section includes settings such as enabling Two-Step Verification for transactions greater than Rp 10,000,000 to enhance security, and the option to Lock Accounting Period to prevent modifications to last month's financial reports. These settings help enforce internal controls and secure the financial data management process.

On the right side, the *Audit Trail (Activity Logs)* section displays recent activity logs, allowing users to track actions such as transaction verification and system-detected anomalies. For instance, the log shows that a user verified a transaction, an anomaly was detected in the expense account, and a user staff changed cash limit settings. This feature ensures transparency and accountability by maintaining a record of all significant system activities, which can be audited to detect any unauthorized actions or discrepancies in financial operations.

3.2 System Functionality Testing Results

The primary focus of the system functionality testing was to assess the core capabilities of the accrual accounting system, including revenue recognition, expense matching, and internal control enforcement. The system was able to successfully automate revenue recognition based on the accrual principle, ensuring that income was recognized when earned, regardless of cash flow. The formula for revenue recognition (i.e., Revenue = Earned Revenue - Unrealized Revenue) was accurately implemented, as demonstrated by test cases where earned revenues were correctly calculated even in the absence of corresponding cash receipts. Similarly, the expense matching module was able to accurately match accrued expenses with the corresponding recognized revenues, following the formula for expense matching (Expense = Accrued Expense - Paid Expense). The system successfully accounted for both paid and unpaid expenses, ensuring that financial data was properly aligned with the accrual accounting method.

Furthermore, the internal control features of the system, such as transaction authorization and segregation of duties, were effectively integrated. All transactions required appropriate authorization before they could be recorded, and the system automatically flagged unauthorized or potentially fraudulent transactions, thus ensuring compliance with internal control standards. The results of the functionality testing indicated that the system met the basic requirements for accrual accounting and internal controls, with no significant issues identified during the simulation phase.

3.3 User Acceptance Testing Results

User Acceptance Testing (UAT) was conducted with a group of SMEs to evaluate the system's usability and practicality in real-world scenarios. A total of 15 SMEs participated in the UAT phase, each using the system for a period of two weeks to manage their financial transactions. The SMEs were asked to perform routine accounting tasks, such as generating financial reports, entering transactions, and reviewing internal control alerts.

The feedback from the SMEs was largely positive, with participants noting that the system was easy to use and provided clear, actionable information. In particular, the user interface was praised for its simplicity and intuitive design, which allowed users with minimal accounting knowledge to operate the system effectively. However, some SMEs indicated that they experienced initial difficulty in understanding the accrual accounting concepts embedded within the system, particularly in distinguishing between earned and unrealized revenues. This feedback suggests the need for additional user training and documentation, which could improve user comprehension and reduce the learning curve for non-experts.

Despite these initial challenges, the overall acceptance rate was high, with 80% of participants reporting that they would be willing to adopt the system for their regular accounting operations. This indicates that the system's practical applicability was well received, and the internal control features were considered beneficial for preventing errors and fraud.

3.4 Anomaly Detection and Fraud Prevention

One of the key features of the proposed system is its ability to detect anomalies and potential fraudulent transactions through machine learning. During testing, a machine learning model trained on historical financial data from participating SMEs was used to classify transactions as legitimate or suspicious. The model applied classification algorithms such as decision trees and support vector machines (SVM) to identify outliers and irregular patterns in the data.

The anomaly detection system achieved a classification accuracy of 92%, with a false-positive rate of 4% and a false-negative rate of 6%. This performance was deemed satisfactory for an early-stage prototype, with the accuracy indicating that the system was effective in identifying fraudulent transactions and potential errors. However, some false positives were recorded, where legitimate transactions were flagged as suspicious. These instances occurred primarily due to legitimate transactions that deviated from typical spending patterns, such as large one-time expenses. Further refinement of the machine learning model, particularly by

incorporating additional features such as transaction context, could reduce these false positives and improve the model's precision.

Overall, the anomaly detection feature proved to be a valuable tool for improving the security and reliability of financial data. SMEs reported increased confidence in their financial reporting, as the system helped to identify and mitigate potential fraud before it could impact financial statements.

3.5 Impact on Financial Reporting and Decision-Making

To assess the impact of the system on financial reporting and decision-making, we compared pre- and post-implementation financial metrics for participating SMEs. Key performance indicators (KPIs) such as financial accuracy, reporting timeliness, and cost control were measured before and after the system was deployed.

The results showed a significant improvement in financial accuracy, with SMEs reporting fewer errors in their financial statements post-implementation. On average, SMEs experienced a 30% reduction in accounting errors, particularly in the areas of revenue recognition and expense matching. Additionally, the system facilitated faster financial reporting, with SMEs reporting a 25% reduction in the time required to close their monthly financial statements. This reduction in reporting time allowed business owners to make more timely decisions based on real-time financial data.

Furthermore, SMEs reported better control over their costs, with the system's expense matching and internal control features contributing to more efficient resource allocation. Participants noted that they were able to identify discrepancies in spending earlier, allowing them to take corrective actions before costs escalated.

3.6 System Limitations and Future Work

Despite the positive results, several limitations were identified during the evaluation process. First, while the system performed well in automating accrual accounting and enforcing internal controls, it still requires further optimization to handle more complex accounting scenarios, such as multi-currency transactions and consolidation of financial statements across multiple entities. Additionally, some SMEs reported issues with the scalability of the system when dealing with large volumes of transactions, suggesting that future work should focus on improving the system's capacity to handle high-volume data.

Another area for improvement is the anomaly detection model, which, while effective, could benefit from additional training data and more sophisticated algorithms. Future iterations of the system will incorporate deeper machine learning techniques, such as deep learning or reinforcement learning, to enhance its ability to detect more complex patterns and reduce false positives.

4. CONCLUSIONS

This research aimed to develop an accrual-based accounting information system integrated with internal control mechanisms for SMEs. The proposed system was designed to automate key accounting functions such as revenue recognition, expense matching, and internal control enforcement. The results demonstrated that the system successfully improved financial reporting accuracy, reduced accounting errors by 30%, and shortened the financial reporting cycle by 25%. The internal control features, including transaction verification and anomaly detection, were effective in preventing fraud and ensuring data integrity, thus enhancing the security of financial processes. Additionally, the user acceptance testing indicated that the system was well-received, with 80% of SMEs expressing willingness to adopt the solution for their operations.

Despite these positive outcomes, several areas for future improvement were identified. The system's scalability needs to be enhanced to handle larger volumes of transactions efficiently, and the machine learning anomaly detection model could benefit from further

refinement to reduce false positives. Future research could explore incorporating multi-currency support and expanding the system's functionalities to include advanced financial forecasting and predictive analytics. Additionally, further training and documentation should be developed to facilitate smoother adoption among users with limited accounting knowledge.

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