UGANDA CHRISTIAN UNIVERSITY

A Centre of Excellence in the Heart of Africa

SMART ACADEMIC PERFORMANCE MONITORING SYSTEM

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COMPREHENSIVE REPORT

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Chapter 1

INTRODUCTION

In Uganda, academic performance monitoring remains a crucial challenge for institutions at various education levels. Many schools and universities rely on manual systems or outdated software to track student progress, attendance, and performance. This leads to inefficiencies, data inconsistencies, and delays in decision-making regarding student progress and intervention strategies.

The Smart Academic Performance Monitoring System (SAMS) is an innovative solution designed to streamline academic tracking by automating student performance monitoring, attendance tracking, and report generation. The system provides a robust platform for real-time data analysis, ensuring timely intervention for students who may require additional support. By integrating modern technologies such as biometric authentication, real-time notifications, and Learning Management System (LMS) interoperability, SAMS enhances efficiency and transparency in academic monitoring.

BACKGROUND

Education plays a significant role in Uganda's socio-economic development, with an increasing focus on improving literacy rates and academic excellence. However, institutions often face challenges such as poor academic tracking, absenteeism, and lack of timely interventions for struggling students. Traditional paper-based record-keeping and decentralized data storage have led to inefficiencies in data retrieval, analysis, and reporting.

With Uganda's growing adoption of technology in various sectors, it is essential to modernize academic monitoring systems to enhance student performance and institutional efficiency. SAMS aims to bridge the gap by offering a digital solution that ensures accuracy, accessibility, and security in academic performance monitoring.

PROBLEM STATEMENT

Uganda's Vision 2040 emphasizes digital innovation to improve education, yet many institutions still rely on manual and fragmented methods for tracking student performance, attendance, and progress. This results in delayed interventions, inaccurate records, and poor communication between teachers, students, and parents. Existing Learning Management Systems (LMS) primarily focus on content delivery rather than real-time performance tracking, automated alerts, and centralized data analytics. Without an integrated solution, issues like falsified attendance records, grading errors, and delayed reports persist, affecting academic outcomes. Addressing this gap aligns with SDG 4 (Quality Education) by enhancing data accuracy, accountability, and proactive student support. The Smart Academic Monitoring System (SAMS) aims to provide an automated, real-time academic tracking platform that improves student performance monitoring, attendance tracking, and report generation, ensuring stakeholders receive timely and actionable insights for better decision-making and learning outcomes.

SIGNIFICANCE OF THE SYSTEM

The Smart Academic Performance Monitoring System (SAMS) is designed to address key academic monitoring challenges through:

1. **Improved Student Performance Monitoring:** Automated tracking of grades, attendance, and participation ensures students receive timely feedback.
2. **Enhanced Attendance Management:** The use of biometric or RFID-based attendance systems eliminates fraudulent attendance recording.
3. **Real-time Alerts and Notifications:** The system provides automated alerts for absenteeism, poor performance, and upcoming academic activities.
4. **Data-Driven Decision Making:** Advanced reporting features enable administrators and teachers to make informed academic interventions.
5. **Increased Parental Engagement:** Parents can access their children's academic reports and receive notifications on performance trends.
6. **Integration with Learning Management Systems:** Seamless synchronization with existing LMS platforms ensures consistency in academic record-keeping.

Chapter 2

Methodology

This chapter outlines the methodology used in the development of the Smart Academic Performance Monitoring System (SAPMS). A combination of qualitative and quantitative data collection techniques—such as interviews, surveys, observations, document analysis, and focus groups—was employed to gather accurate system requirements from key stakeholders. The methodology focused on addressing real challenges in academic monitoring, including poor attendance tracking, delayed reporting, and lack of real-time feedback. The insights gathered directly informed the system's core functionalities, such as performance tracking, automated attendance, real-time alerts, secure access control, and integration with Learning Management Systems (LMS). Development was guided by practical assumptions, including stable internet access, institutional hardware support, minimal user training, and strong administrative backing to ensure effective implementation and adoption.

INFORMATION COLLECTION TECHNIQUES

To define system requirements, a combination of qualitative and quantitative techniques was employed to ensure accuracy and completeness. The following tools and techniques were used:

a) Interviews & Surveys

- Conducted structured interviews with students, lecturers, and administrators to understand their academic monitoring needs.
- Used surveys to collect quantitative feedback on existing challenges and areas of improvement.

- Identified pain points related to attendance tracking, performance evaluation, and communication gaps in academic progress monitoring.

b) Observation

- Observed academic monitoring processes within institutions to understand current workflows.
- Identified inefficiencies in attendance tracking, grade monitoring, and reporting mechanisms.
- Noted challenges such as human errors in manual attendance marking where some people record attendance for people who are absent and delays in academic reporting.

c) **Document Analysis**

- Reviewed institutional policies, grading guidelines, and academic regulations to ensure compliance.
- Analysed best practices from existing academic tracking systems for benchmarking.
- Examined integration possibilities with Learning Management Systems (LMS) used by various institutions.

d) **Focus Groups**

- Organized discussion groups with key stakeholders (students, lecturers, academic advisors, and IT administrators) to brainstorm essential features.
- Collected insights on usability, preferred notification methods, and critical functionalities.
- Validated initial requirements and made refinements based on feedback.

Functional Requirements

Based on the collected data, the following functional requirements were established:

a) Student Performance Tracking

- Systematically records student grades, attendance, and participation data.
- Provides automated progress reports with graphical performance trends.
- Allows lecturers to input and update student performance records easily.

b) Attendance Monitoring

- Supports automated attendance tracking using biometric scanners or RFID technology.
- Provides a manual entry option for special cases such as system downtime or student exemptions.
- Enables real-time verification of attendance records for accuracy.

c) Real-time Notifications

- Sends automated alerts for low attendance, missing assignments, and poor performance.

- Provides notifications for upcoming exams, assignment deadlines, and important academic events.
- Allows students and academic advisors to set up custom alerts for personalized tracking.

d) Report Generation

- Generates detailed academic reports for students, lecturers, and administrators.
- Includes graphical visualizations for performance trends and attendance summaries.
- Supports exportable reports in formats such as PDF and Excel for easy sharing.

e) Access Control & Security

- Implements role-based access control for students, lecturers, and administrators.
- Ensures secure login authentication through multi-factor authentication (MFA).
- Uses encryption techniques to protect sensitive student data.

f) Integration with Learning Management Systems (LMS)

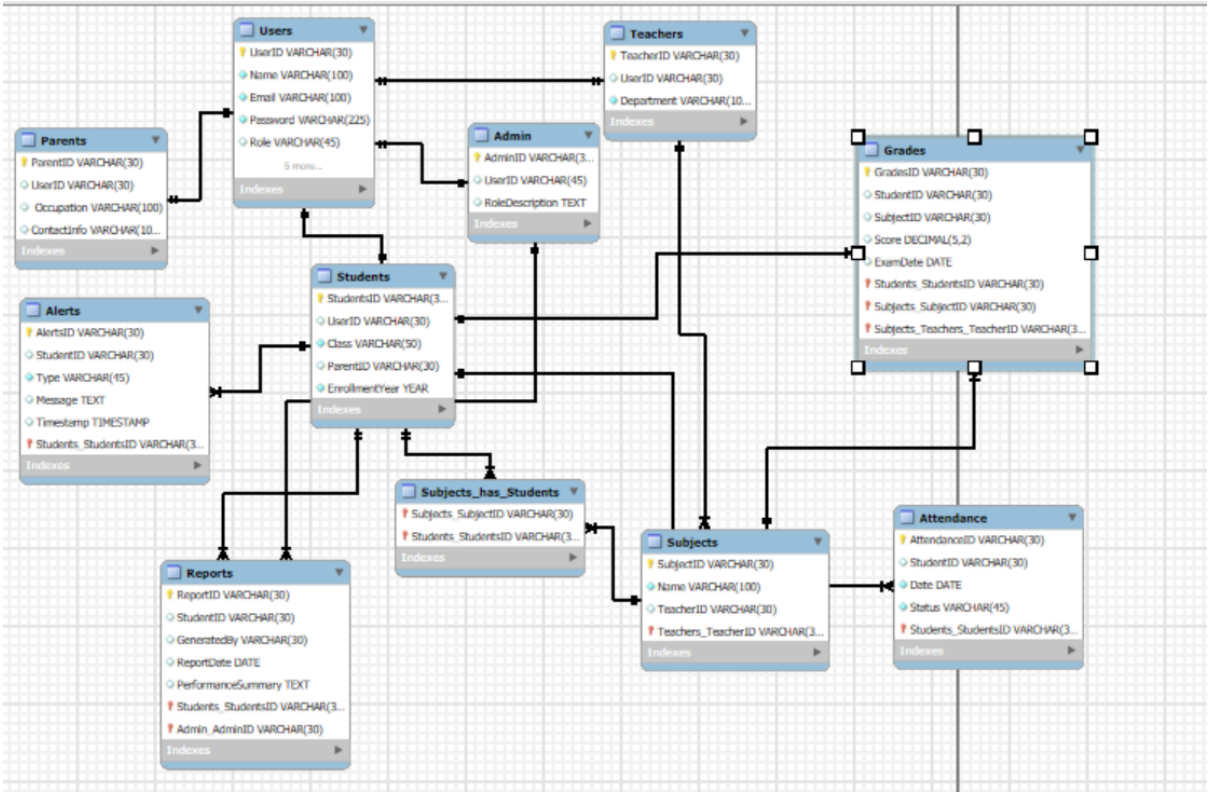
- Seamlessly integrates with existing LMS platforms (e.g., Moodle, Blackboard, Google Classroom).
- Allows automatic synchronization of academic records between SAMS and LMS.
- Supports data import/export functionalities for enhanced interoperability.

ASSUMPTIONS

To facilitate system development and implementation, the following assumptions are made:

- Stable Internet Access: Users will have internet connectivity to access online functionalities.
- Institutional Hardware Support: Schools will provide necessary hardware such as biometric scanners, RFID readers, and dedicated servers for hosting the system.
- Minimal Training Requirement: Students, lecturers, and administrators will require minimal training to effectively use the system.
- Data Privacy & Security Compliance: The system will adhere to strict data privacy and security policies to protect user information.
- Administrative Support: The institution’s administration will actively support the implementation and ensure user adoption of the system.
- Alert Generation Condition: Alerts will only be generated when a student receives low marks in assessments or exams.

ENTITY RELATIONSHIP DIAGRAM



RELATIONSHIPS

1. A **User** can be categorized as a **Student, Teacher, Parent, or Admin**.
2. A **Student** is linked to a **Parent** for monitoring purposes.
3. A **Teacher** is responsible for teaching multiple **Subjects**.
4. A **Student** is enrolled in multiple **Subjects**.
5. A **Student** has multiple **Grades**, each associated with a specific **Subject**.
6. A **Student** has multiple **Attendance** records tracked over time.
7. **Alerts** are generated based on student performance and attendance issues.
8. **Reports** provide an overview of student progress, generated by an **Admin** or **Teacher**.

BUSINESS RULES

1. A **Student** must be enrolled in at least one **Subject**.
2. A **Teacher** must be assigned to at least one **Subject**.
3. **Grades** must range between **0 and 100**.
4. **Alerts** must be triggered if a student scores below **40%**.
5. **Attendance records** should be updated daily.

6. **Administrators** should have full access to modify, update, and generate system-wide reports.
7. **Students and Parents** should only view performance records and receive notifications related to their profiles.
8. **Teachers** can only update grades and attendance records for students assigned to their subjects.

Chapter 3

System Design and Development

The design and development of the Smart Academic Performance Monitoring System (SAPMS) involved structured procedures to ensure data accuracy and system efficiency. Constraints like primary and foreign keys, maintained data integrity, while stored procedures automated key operations. Views and joins enabled efficient data retrieval across related tables, and CASE statements handled conditional logic such as grade categorization. Triggers were used to automate alerts and updates, ensuring real-time system responsiveness.

Tables and Entities Overview

The **Academic Performance Monitoring System** is built around interrelated tables that represent key academic entities. The **Users** table serves as the central identity store for all roles (Admins, Teachers, Students, and Parents), with each role extended in their respective tables.

- **Students** are linked to **Users** and **Parents**, while **Teachers** manage subjects through the **Subjects** table.
- **Grades** capture student performance by subject, and **Attendance** tracks daily student presence.
- **Alerts** notify users about performance issues or absenteeism, and **Reports** summarize student performance.

Foreign keys ensure data integrity, and constraints enforce valid inputs, such as score ranges and attendance status.

Constraints

- Unique Emails and Contacts: Ensures each user's email and contact number are unique, preventing duplicates.
- Grade Score Range (0-100): Validates that grades are within the 0-100 range, ensuring accurate academic records.

- Attendance Status: Ensures attendance is marked as either 'Present' or 'Absent', maintaining consistency in tracking.
- Role Validation: Restricts user roles to "Admin", "Teacher", "Student", or "Parent", ensuring correct role assignments.

Views

These are some of the views implemented;

- ✓ StudentGrades: Displays all student grades along with the associated subject, score, and exam date. This view consolidates performance data, providing a clear and comprehensive overview of student academic progress.
- ✓ Low_Performance_Students: Identifies and counts students with scores below 50. This view is crucial for quickly pinpointing at-risk students who may need academic intervention.
- ✓ AttendanceRecords: Lists all attendance records, showing student status (Present/Absent) for each date. It helps track student attendance patterns, identify issues with absenteeism, and ensures accurate reporting.
- ✓ Reports_Per_Admin: Summarizes the number of reports generated by each admin. This view helps track administrative activity and workload distribution, offering insights into the frequency and volume of report generation.

Privileges and Roles

the **Academic Performance Monitoring System**, user roles and privileges are designed to ensure proper access control and maintain data security. Here's a summary of how roles and privileges are managed:

1. **Admin Role**: The **admin_user** has full access to all system tables and features, with all privileges granted across the entire database (ALL PRIVILEGES). This allows the admin to manage users, monitor academic data, and generate reports, ensuring they can perform any administrative task in the system.

2. **Teacher Role**: The **teacher_user** is granted the ability to view, insert, and update data in the **Grades** and **Attendance** tables, but cannot delete records or modify user information. This ensures teachers can track and manage student performance without affecting the integrity of the overall system.

3. **Student Role**: The **student_user** can only **view** their own grades, reports, and attendance records, ensuring privacy and restricting access to other students' data. This ensures students have access to their academic information but no ability to alter it.

4. **Parent Role**: The **parent_user** can view their child's performance by accessing the **Grades**, **Attendance**, **Students**, and **Alerts** tables. This allows parents to monitor their child's academic progress while ensuring they cannot modify data.

Additionally, **security measures** are implemented to prevent users from granting privileges to others, ensuring that only authorized admins can control access rights.

By carefully defining and enforcing these roles and privileges, the system maintains proper access control, data integrity, and security.

Procedures Summary

Several stored procedures were implemented to facilitate database interactions, automate repetitive tasks, and enhance system efficiency:

1. **Add User** – Adds a new user to the system with essential attributes including name, email, role (Admin, Teacher, Student, or Parent), and contact details.
2. **GetStudentsByClass** – Retrieves all students enrolled in a specified class, along with their user information and enrolment year.
3. **GetSubjectsByTeacher** – Lists all subjects assigned to a specific teacher, showing both subject and teacher details.
4. **GetStudentPerformance** – Displays a student's academic performance, including subject names, scores, and exam dates.
5. **GetStudentAlerts** – Retrieves all alerts linked to a particular student, including type, message content, and timestamp.
6. **GetReportsByAdmin** – Fetches performance reports generated by a specified admin, showing associated student information and summaries.
7. **CountUsersByRole** – Returns the number of users in the system categorized by their role (e.g., Student, Teacher, Parent, Admin).
8. **UpdateStudentReport** – Allows an admin to update an existing performance report with new observations and automatically records the current date.

These procedures streamline data management, enhance user experience, and maintain data integrity throughout the academic monitoring process.

Conclusion

The Smart Academic Performance Monitoring System has been designed to provide a robust, efficient, and user-friendly platform for managing and tracking academic performance within educational institutions. By integrating multiple user roles—administrators, teachers, students, and parents—the system ensures seamless communication, timely feedback, and data-driven decision-making. Key features such as **automated grade tracking, performance reporting, real-time alerts, and centralized user management** collectively contribute to a smarter and more accountable academic environment. The use of stored procedures has further optimized database operations, enhancing performance, security, and scalability.

Ultimately, this system not only improves academic monitoring and reporting but also empowers stakeholders with timely insights, promoting transparency, collaboration, and continuous improvement in the learning process.

In alignment with **Sustainable Development Goal 4: Quality Education**, the system promotes inclusive and equitable access to education by supporting early intervention, personalized feedback, and active engagement from both educators and guardians. Through data-driven insights and improved academic accountability, it fosters better learning outcomes and ensures that no student is left behind.