11ᵗʰ ISC 2024 (Universitas Advent Indonesia, Indonesia)

"Research and Education Sustainability: Unlocking Opportunities in Shaping Today's Generation Decision Making and Building Connections" October 22-23, 2024

GOSHEN Group Management System: Automating Student Grouping, Activity, and Attendance Management for Universitas Advent Indonesia

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ABSTRACT

In today's academic environment, the need for efficient management of student groups, activities, and attendance is increasingly evident. Traditional methods of managing groups and tracking attendance using paper, Excel, or Google Sheets often result in inefficiencies such as human errors, time consumption, and lack of real-time coordination. To address these challenges, we developed the GOSHEN Group Management System (GGMS) for Universitas Advent Indonesia. GOSHEN stands for *Go, Share, and Encourage*, reflecting the mission of Christian fellowship through small groups within the university. The system automates the grouping of students based on various criteria, including dormitory assignments, and provides features such as leader and secretary assignments, academic year considerations, manual adjustments, and attendance tracking. GGMS also manages mid-week worship activities, Sabbath school discussions, and prayer circles, allowing sponsors (staff or lecturers) to lead the groups. Built using SQL Server, Laravel, and VueJS as a Single Page Application (SPA), GGMS offers a robust and scalable solution to efficiently manage student group activities and attendance. This paper outlines the system's functionalities, its development process, and the significant improvements it offers compared to manual methods.

Keywords: Automated Group Management, Attendance Tracking System, Student Activity Management, Educational Technology.

INTRODUCTION

Efficient group management is essential for fostering a connected and engaged student community, particularly within religious institutions like Universitas Advent Indonesia (UNAI). As a boarding university where students are required to live in on-campus dormitories, UNAI places a strong emphasis on monitoring attendance and organizing students for various academic and spiritual activities. A key initiative driving the need for structured group management is the GOSHEN program, which stands for *Go, Share, and Encourage*. This program aligns with the mission of Christian fellowship through small groups, inspired by the educational principles of Ellen G. White, one of the founders of the Seventh-day Adventist Church, to which UNAI belongs. White's teachings emphasize the importance of holistic

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education—spiritual, mental, and physical development—and promote community-based learning, collaborative engagement, and character building. Through the GOSHEN program, UNAI seeks to foster spiritual growth, collaborative learning, and community engagement, in line with the broader mission of the Seventh-day Adventist Church.

Under the GOSHEN program, students are assigned to small groups led by faculty and staff sponsors. These groups meet twice a month at faculty housing located on campus, as well as during Sabbath School discussions. The close proximity of faculty housing to student dormitories is one of UNAI's strengths, promoting meaningful connections between students and staff. However, the logistical challenge of assigning thousands of students to groups, especially with the inclusion of those living off-campus, makes manual group management impractical.

Traditionally, UNAI has relied on manual systems, including paper forms and spreadsheet tools like Microsoft Excel or Google Sheets, to manage student groups and activities. While these tools provide basic organizational capabilities, they are not equipped to handle the complexities of dynamic student grouping, leadership assignments, and real-time attendance tracking. The manual nature of these systems leads to several challenges:

- Human Errors: Manual data entry is prone to mistakes, such as assigning students to multiple groups, forgetting to update attendance, or misrecording essential data. Research shows that human error is common in manual systems, impacting overall performance management (Verma & Sood, 2017).

- Time Consumption: Administrative staff and instructors spend considerable time organizing groups, updating attendance records, and scheduling activities. Studies have demonstrated that automated systems, such as the Group Assignment Tool, can significantly reduce the time required for these tasks compared to manual processes (Miller & Bonfert-Taylor, 2020).

- Lack of Real-Time Updates: Manual systems often fail to provide immediate updates, leading to inefficiencies in communication and coordination. Automated systems that enable real-time data synchronization can resolve these issues by ensuring that all information is current (Srimathi et al., 2022).

- Scalability Issues: As the student population grows, managing large datasets manually becomes increasingly difficult, leading to delays and bottlenecks. Automated systems are better equipped to handle large numbers of students, ensuring smooth group management (Verma & Sood, 2017).

Given these challenges, the GOSHEN Group Management System (GGMS) has been developed to provide a scalable, efficient, and flexible solution. GGMS dynamically organizes students into groups, assigns leadership roles, schedules activities, and tracks attendance in real-time. This system is specifically designed to meet the demands of the GOSHEN program, ensuring a more effective and streamlined management process that enhances the student experience at UNAI.

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LITERATURE REVIEWS

In today's academic environment, the need for efficient management of student groups, activities, and attendance is increasingly evident. Traditional methods often result in inefficiencies such as human errors, time consumption, and lack of real-time coordination. Several studies have examined automated systems for student management, offering valuable insights into their solutions and limitations.

1. Srimathi et al. (2022) developed the *Institution Management System (IMS)*, designed to manage student records, academic details, and event attendance. While this system effectively addresses the issue of redundant student information and simplifies administrative processes, it does not specifically target dynamic group management or real-time updates needed for frequent small group activities like in Universitas Advent Indonesia (Srimathi et al., 2022). Drawback The system does not offer customizable group management or scheduling tools, limiting its applicability for handling the dynamic and frequent group activities essential for fostering community and spiritual engagement in religious institutions like UNAI

2. Jonathan et al. (2019) proposed an *Online Clearance System* for educational institutions. This system focuses on streamlining student clearance procedures, which can be time-consuming and error-prone when handled manually. Although the system automates administrative tasks, it does not address group management, leader assignments, or attendance tracking for recurring activities (Jonathan et al., 2019).

   Drawback: The solution is narrowly focused on clearance processes and lacks flexibility for broader student management tasks like activity scheduling, which are essential for managing ongoing group-based spiritual and academic activities at UNAI.

3. Verma and Sood (2017) explored an *Internet of Things (IoT)-based student performance evaluation system*. This system uses data mining algorithms to evaluate students based on spatial-temporal patterns collected through sensors, providing a comprehensive view of student performance beyond academics. However, it does not facilitate real-time group formation or dynamic scheduling, which are critical for managing frequent group-based activities (Verma & Sood, 2017).

   Drawback: While beneficial for performance tracking, the system lacks specific tools for dynamic group management and real-time updates, which are essential for managing spiritual and collaborative learning activities in an institution like UNAI.

4. Mekhonoshin et al. (2016) developed a system for *automated group class organization*, helping teachers to form working subgroups based on students' knowledge levels and personal characteristics. This system provides automated group formation but does not account for frequent group adjustments or manage attendance tracking, limiting its utility in dynamic group environments (Mekhonoshin et al., 2016).

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Drawback: The system lacks flexibility for real-time adjustments and dynamic group reassignments, which are essential for managing the ongoing and evolving group-based activities at UNAI.

5. Ramos et al. (2021) proposed a *group formation system for collaborative learning* using learning paths and k-means clustering. While the system allows for automated group recommendations, its primary focus on collaborative learning limits its broader application for managing various types of student activities, such as worship sessions and prayer circles (Ramos et al., 2021).

   Drawback: The system does not cover leadership assignments or activity scheduling, both of which are crucial for managing the holistic group activities at UNAI that include both spiritual and academic dimensions.

6. Oyebola et al. (2018) developed a *fingerprint-based attendance management system*. This biometric system improves accuracy and security in attendance tracking, eliminating common issues with manual methods. However, it does not offer solutions for group assignments or managing student activities (Oyebola et al., 2018).

   Drawback: Focused primarily on attendance tracking, the system lacks comprehensive group and activity management capabilities, which are critical for managing both academic and spiritual group activities at UNAI.

7. Gordillo (2019) examined the use of automated assessment tools in programming courses, finding that automation improves motivation and student performance. However, the tool's focus is on academic assessments, with no provisions for group formation or activity management (Gordillo, 2019).

   Drawback: The system does not address non-academic group management or dynamic activities, both of which are central to managing the holistic educational experience at UNAI.

8. El-Salhi et al. (2019) developed an *Automated Attendance Management System* using barcode readers. The system streamlines attendance registration but, like other attendance-focused systems, does not incorporate group management or leadership roles (El-Salhi et al., 2019).

   Drawback: The system is limited to attendance tracking and does not address the broader student management needs, such as group assignments and leadership roles, which are essential at UNAI.

9. Rizvi (2021) developed a *Placement Management System* for colleges, focusing on managing placement-related activities and student data. While beneficial for managing student data and job postings, it lacks tools for managing student groups and activities (Rizvi, 2021).

   Drawback: The system is specialized for placement management and does not cover the dynamic needs of group management and activity scheduling required at UNAI

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Given these challenges, it is evident that existing automated systems fall short of addressing the specific needs of dynamic group management, leadership assignments, and real-time attendance tracking required at institutions like UNAI. The **GOSHEN Group Management System (GGMS)** addresses these issues by offering a scalable, efficient, and flexible solution. It is specifically designed to dynamically organize students into groups, assign leadership roles, schedule activities, and track attendance in real time, ensuring that the spiritual and academic objectives of UNAI are met through structured and efficient group management.

METHODS

GGMS was developed using SQL Server for database management, Laravel for backend logic, and VueJS SPA for a responsive user interface. The development process followed the Rapid Application Development (RAD) model as shown in Figure 1, which allowed for iterative prototyping and frequent user feedback. This approach ensured that the system met the unique needs of Universitas Advent Indonesia.
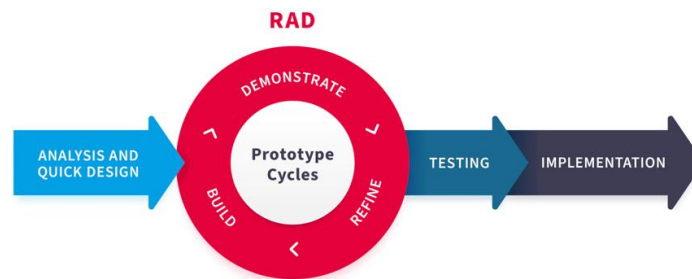

Figure 1. Rapid Application Development Methodology

Key steps in the development process:

1. **Quick Design and Analysis**: Initial design focused on the core requirements—automating student grouping based on dormitory assignments, academic year, and special cases such as "outside" students. We also ensured the flexibility to manually assign group leaders and secretaries, as well as track attendance efficiently.

2. **Prototype Cycles**: Successive versions were built, demonstrated to users, and refined based on feedback. These cycles helped fine-tune features like group activity management, leader assignments, attendance tracking, and group-level adjustments.

3. **Testing and Implementation**: Rigorous testing was conducted to ensure the system's reliability. The final version was deployed within Universitas Advent Indonesia for operational use, replacing manual methods and significantly improving user experience.

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Application Design

The proposed application offers several key features that enhance group and attendance management efficiency as shown in Figure 2 below.
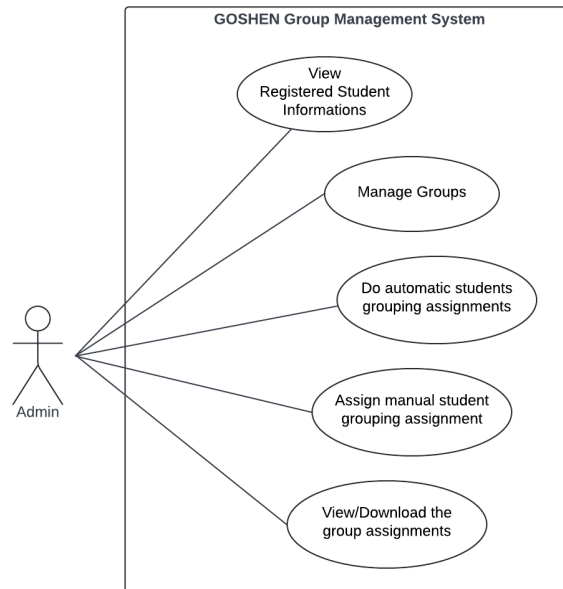

Figure 2. **Use Case Diagram of the Proposed GOSHEN Group Management System**

In the Figure 2 there is one actor, that is Admin. This role is central to the system's operation, representing the administrator who interacts directly with the GOSHEN Group Management System. The admin is responsible for overseeing the entire lifecycle of student group management, from initial registration to final group assignments and attendance tracking. There are several use cases that are highlighted the main purpose of this paper that is for automating the student grouping:

1. **View Registered Student Information:**

    This function serves as the administrative portal to all registered student data within the system. It allows the admin to access comprehensive profiles that include academic, personal, and dormitory details—critical inputs for effective group segmentation.

2. **Manage Groups:**

    A multifaceted functionality that encompasses several critical tasks, enabling the admin to create, adjust, and monitor student groups throughout the academic cycle.

3. **Do Automatic Students Grouping Assignments:**

    Utilizes a sophisticated algorithm to automatically assign students to groups based on predefined criteria such as dormitory arrangements and academic year. This automated process

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ensures efficiency and consistency in group formation, reducing the administrative burden and potential for human error.

4. Assign Manual Student Grouping Assignment:

ffers the necessary tools for manual intervention in the grouping process, allowing for customization and flexibility. This feature is essential for addressing special cases or preferences that may not be adequately served by the automated system.

5. View/Download the Group Assignments:

Provides a comprehensive overview of all group assignments, enabling the admin to download reports for offline analysis or sharing with other stakeholders. This feature supports transparency and facilitates further administrative planning, review and information dissemination in preformatted PDF files that are easily shareable.

Database Schema

The database schema outlined in the diagram is structured to efficiently manage and organize student, academic, and housing data for an educational institution. It includes several interconnected tables designed to handle various aspects of student information and academic grouping:

1. **Students Table**: Central to the schema, this table stores essential information about each student, including a unique student ID, name, major, and religion, linking to the respective majors and religions tables through foreign keys.

2. **Majors and Faculties Tables**: These tables catalog the academic programs and faculties offered by the institution. Each major is associated with a faculty, and each student is linked to a specific major, allowing for detailed academic tracking and management.

3. **Religions Table**: This holds data on the various religious affiliations that can be associated with students, aiding in the institution's ability to respect and manage religious diversity.

4. **Groups Table**: Used for managing extracurricular or academic group assignments, this table includes information on each group's name and sponsor, facilitating organized group activities and sponsorships.

5. **Group Allocations Table**: Connects students to specific groups and logs the academic period of their membership using a link to the academic_periods table, which tracks the current academic year and semester.

6. **Dormitories and Dormitory Rooms Tables**: These handle housing arrangements by maintaining records on dormitory buildings and individual rooms, respectively. The

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dormitory_rooms table is linked to dormitories through a foreign key, ensuring each room is associated with a specific dormitory.

7. **Student Dormitory Assignments Table**: Manages which students are assigned to specific dormitory rooms and tracks these assignments by academic periods, linking back to the students, dormitory_rooms, and academic_periods tables.

8. **Academic Periods Table**: A crucial component for tracking the timeline of all academic activities, it includes fields for the academic year, semester, and an indicator if it is the current period. This table supports other tables in referencing specific academic terms for activities like group allocations and dorm assignments.
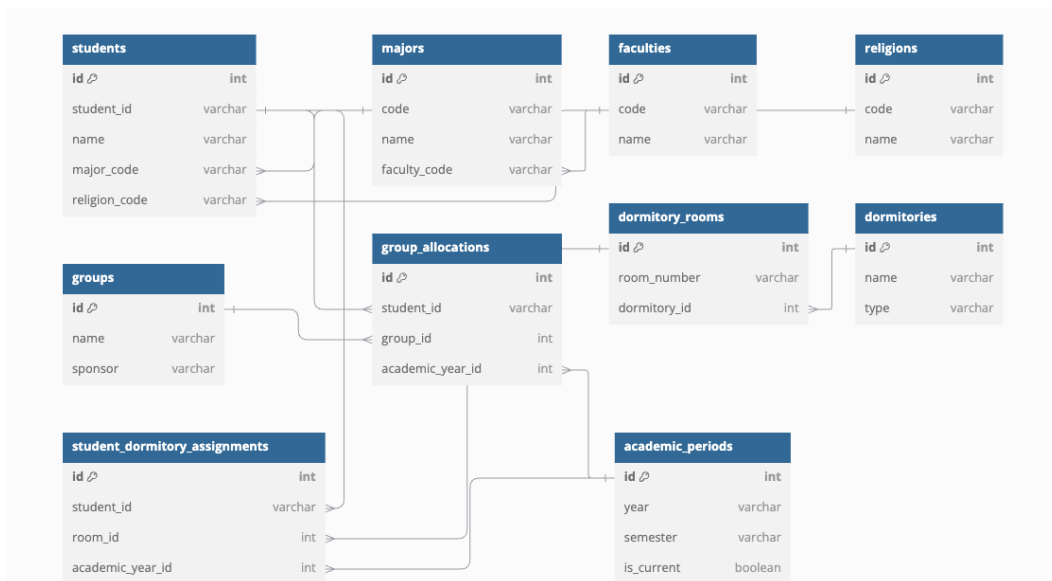

Figure 3. **Database diagram of the proposed GGSM application**

Automatic Student Grouping Process

The main functionality of the application is to allocate the students into different groups according to a defined criteria. Figure 3 illustrates the algorithm that processes the students grouping.
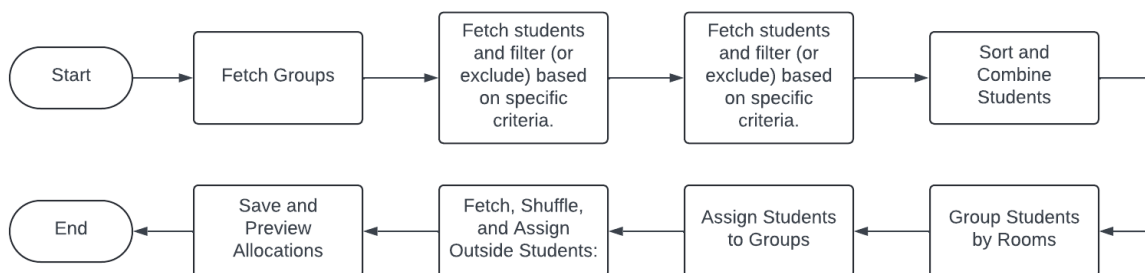
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Figure 3. **Flowchart of the Automatic Group Student Group Assignment**

Step 1: Start

- This is the initial point where the allocation process begins.

Step 2: Fetch Groups

- The system retrieves groups from the database. These groups are predetermined collections into which students will be allocated.

Step 3: Fetch students and filter (or exclude) based on specific criteria.

- This step involves querying for students and applying specific filters to exclude those who meet certain conditions, such as being from particular programs or having specific statuses.

Step 4: Sort and Combine Students

- After obtaining the filtered list of students, they are sorted—typically by attributes such as dormitory assignment—and then combined into a unified list for further processing.

Step 5: Group Students by Rooms

- In this step, students are grouped according to their room assignments. This typically means grouping students who share the same room or adjacent rooms.

Step 6: Assign Students to Groups

- The previously formed room-based student groups are now assigned to the broader groups (kelompok) retrieved in Step 2. This is done in a manner that aims for an equitable distribution.

Step 7: Fetch, Shuffle, and Assign Outside Students

- Students who are not housed in dormitories (outside students) are fetched, their order is randomized to ensure fairness, and they are then distributed among the existing groups.

Step 8: Save and Preview Allocations

- All student allocations to groups are saved, typically in a database or a temporary storage solution. A preview of these allocations is then generated for review or further action.

Step 9: End

- The process concludes, having completed all necessary steps for allocating students to groups.

RESULTS AND DISCUSSION

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The usage of protoyping method allows for fast development and delivery of the proposed application. The application is implemented using the data in first semester of 2024/2025 academic year at Universitas Advent Indonesia.
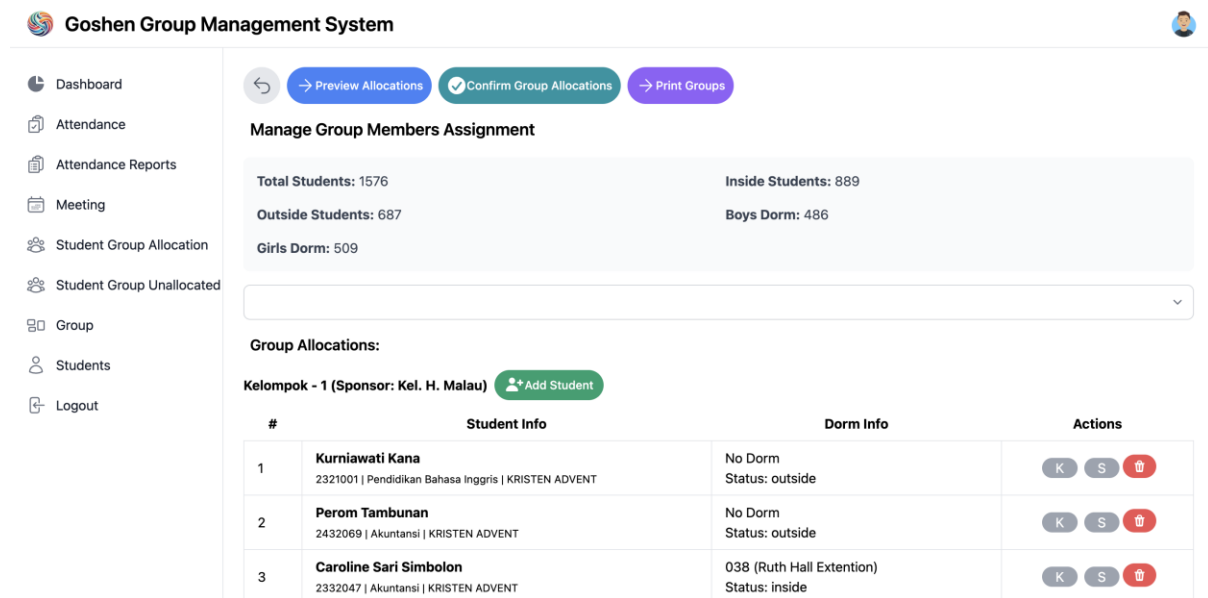

Figure 4. **GGMS Application showing Manage Group Member Assignment Page**

Figure 4 displays a user interface from the proposed GGMS system. On the left side, the interface features a vertical navigation menu offering quick access to various system functionalities such as Dashboard, Attendance, Attendance Reports, Meeting, Student Group Allocation, and more. At the top of the main panel, there are buttons for previewing, confirming, and printing group allocations, enhancing the workflow for managing group assignments.

The interface is particularly focused on the management of student groups, showing detailed statistics about the student population directly above a list of group allocations. These statistics segment the students into categories such as total students, those residing inside or outside of dormitories, and further divisions within the dorms themselves. Each group is identified by a number and a sponsor's name, with functionalities available for adding students to groups directly from this interface.

Below these summary details, the system lists individual groups with detailed tables displaying each student's name, ID, major, religious affiliation, and dormitory information, reflecting whether they reside inside or outside of dorm facilities. This arrangement not only simplifies the task of managing large numbers of students but also supports administrators in making informed decisions when assigning students to groups based on specific criteria. The table also includes action buttons for assigning leader (K button) and Secretary (S button),

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demonstrating the system's capabilities for detailed and dynamic group management. Overall, the GGMBS works as a robust tool designed to streamline the organization and management of student groups, catering to the diverse administrative needs of educational institutions.

The GOSHEN Group Management System brings several key improvements over traditional manual methods, particularly in attendance tracking:

- Reduced Human Errors: The system's automation of student grouping and attendance management minimizes errors in group assignments and attendance records.

- Time Efficiency: Administrative staff save significant time previously spent manually organizing groups and tracking attendance.

- Enhanced Communication: Real-time updates ensure that students, sponsors, and staff are always aware of group activities and any changes made to schedules, assignments, or attendance statuses.

- Comprehensive Attendance Tracking: The system's ability to log and report attendance statuses in real-time allows sponsors to monitor student engagement during activities. The generation of attendance reports helps staff make data-driven decisions to improve student participation and involvement in group activities.

- Scalability: As the student population grows, GGMS can easily scale to manage additional groups, activities, and attendance records without compromising performance.

The transition from manual methods or simple spreadsheet solutions like Excel or Google Sheets to an integrated system like GGMS offers clear advantages in accuracy, efficiency, and coordination. Furthermore, the system's alignment with the university's mission enhances student participation in religious and social activities, fostering a stronger sense of community.

CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

The GOSHEN Group Management System is a transformative tool for managing student groups and attendance at Universitas Advent Indonesia. By automating the complex process of grouping students, assigning leaders, managing activities, and tracking attendance, GGMS streamlines operations, reduces errors, and saves time. Additionally, it supports the university's mission to foster a spiritually active and engaged student body through its seamless integration of religious activities.

Future work will focus on expanding the system's functionalities to accommodate more flexible group configurations and integrating additional features like event reminders and extended attendance reporting capabilities. As GGMS continues to evolve, it promises to serve as a model for other institutions seeking to improve group management, activity coordination, and attendance tracking.

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REFERENCES

El-Salhi, S. M., Saleh, S. A. H., & Al-Amro, I. I. (2019). Towards developing an automated attendance management system using barcode reader: Hashemite University as a case study. *International Journal of Business Information Systems, 31*(1), 69-85. https://doi.org/10.1504/IJBIS.2019.10021041

Gordillo, A. (2019). Effect of an instructor-centered tool for automatic assessment of programming assignments on students' perceptions and performance. *Sustainability*, 11(20), 5568. https://doi.org/10.3390/su11205568

Jonathan, O., Misra, S., Makinde, F., Damaševičius, R., Maskeliūnas, R., & León, M. (2019). Development of an online clearance system for an educational institution. In *Information Systems and Technologies to Support Learning* (pp. 327-339). Springer. https://doi.org/10.1007/978-3-030-32475-9_24

Mekhonoshin, A., Denisova, A., & Gorlushkina, N. (2016). Organization of group classes through an automated system. In *Information and Communication Technology in Education, Research, and Industrial Applications* (pp. 333-343). Springer. https://doi.org/10.1007/978-3-319-49700-6_31

Ramos, I. M. M., Ramos, D. B., Gadelha, B. F., & de Oliveira, E. H. T. (2021). An approach to group formation in collaborative learning using learning paths in learning management systems. *IEEE Transactions on Learning Technologies, 14*(4), 555-567. https://doi.org/10.1109/TLT.2021.3117916

Rizvi, F. (2021). Placement management system. *International Journal for Research in Applied Science and Engineering Technology*. https://doi.org/10.22214/IJRASET.2021.32641

Rymar, P., & Voytko, B. (2021). Development of an automated system for the formation of schedules of educational lessons using 1C: Enterprise. *Herald of Khmelnytskyi National University*. https://doi.org/10.31891/2307-5732-2021-301-5-36-40

Srimathi, R., Naskath, J., Mathavan, B. A., Pown, T. A., & Rabiya, M. S. (2022). Institution Management System: Student Module. In *2022 Fourth International Conference on Cognitive Computing and Information Processing (CCIP)* (pp. 1-8). https://doi.org/10.1109/CCIP57447.2022.10058674

Verma, P., & Sood, S. (2017). Internet of Things-based student performance evaluation framework. *Behaviour & Information Technology, 37*(1), 102-119. https://doi.org/10.1080/0144929X.2017.1407824

Oyebola, B., Olabisi, K. O., & Adewale, O. S. (2018). Fingerprint for personal identification: A developed system for students attendance information management. *American Journal of Embedded Systems and Applications, 6*(1), 1-11. https://doi.org/10.11648/J.AJESA.20180601.11