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## Development of a Mobile-first, User-Centric Sabbath School Digital Attendance System using RAD with API Integration: A Case Study of Universitas Advent Indonesia

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In the contemporary digital era, the value of adopting agile and user-centric strategies when developing digital solutions is clear. Our research aimed to create a mobile-first, user-centric Sabbath School digital attendance system specifically for Universitas Advent Indonesia. The existing attendance mechanisms were hindered by the inefficiencies of traditional paper-based methods. To address this, we developed a unique single-page application (SPA) optimized for fast load times and continuous user interactions, removing the need for repeated page reloads. Built using Rapid Application Development (RAD) principles and enhanced by iterative processes, this mobile-first SPA is anchored by a strong API, ensuring dependable integrations and reliable data handling. Our new system addresses the drawbacks and environmental issues associated with paper-based attendance. It features real-time tracking, versatile status categories (e.g., present, excused, sick, late), and the ability to produce a range of attendance reports. Furthermore, the system supports group-specific attendance records, detailed metrics, easy-to-use scheduling for attendance-centric meetings, and streamlined student group management. Users can also create groups with individual names, locations, and statuses. The introduction of our approach resulted in a marked improvement in efficiency and user satisfaction, significantly surpassing the old paper-based methods. Given its flexible design, the system's potential uses could extend beyond educational institutions into wider community areas, including churches. Moving forward, research should investigate the many ways this innovative digital tool can be applied, opening up opportunities for various institutions to harness its benefits.

***Keywords:*** *mobile-first approach, rapid application development (RAD), digital attendance system, user-centric design, API-based system*

In today's rapidly changing educational landscape, there's a palpable urgency for institutions to shift from traditional, manual operations to more agile, digital alternatives. This shift is propelled by the need to enhance operational efficiency and meet the swift pace of current academic and administrative demands. In this context, the reliance of Universitas Advent Indonesia on paper-based attendance systems presents a stark dichotomy. As an institution grounded in Seventh-day Adventist educational traditions, it encounters unique challenges that render the implementation of a contemporary attendance system not just beneficial but essential.

The drawbacks of manual attendance are manifold. They are prone to human error, compromising data integrity (Ali et al., 2022), consume excessive time that could otherwise be devoted to teaching (Ali et al., 2022), and the handling and storage of physical records are inefficient (Haleem, Javaid, Qadri, & Suman, 2022). In an era where environmental concerns are paramount, the excessive paper usage also raises sustainability issues (Haleem, Javaid, Qadri, & Suman, 2022). Moreover, the susceptibility of paper to damage or loss poses a risk to the long-term maintenance of records.

For Universitas Advent Indonesia, these challenges are not merely hypothetical but are amplified by its unique needs and the cultural nuances of the Seventh-day Adventist educational model. These challenges become particularly conspicuous during Sabbath School, where the logistical demands of managing large congregations underscore the inefficiencies inherent in paper-based systems (Haleem, Javaid, Qadri, & Suman, 2022).

Our research endeavors to develop a mobile-first, user-centric Sabbath School digital attendance system that transcends the limitations of conventional methodologies. It aims to be a system that's not only aligned with the digitalization trend but also flexible, intuitive, and responsive to the specific needs of the community. By leveraging a smart classroom attendance management system integrated with Internet of Things technology, previous research could achieve precise attendance tracking and gain valuable insights into attendance trends (Zhao, Zhao, & Qu, 2022), ultimately enhancing student engagement and pedagogical effectiveness (Valverde-Berrocoso, Acevedo-Borrega, & Cerezo-Pizarro, 2022).

Acknowledging these imperatives, the goal of our research is not just to replace paper with pixels but to ensure that the digital solution is finely tuned to user requirements and the nuances of the digital age. The aspiration is to craft a system that is adaptable, intuitive, and meets the dynamic demands of modern users, particularly within the energetic academic and religious milieu of Universitas Advent Indonesia. Through this initiative, we aim to pioneer in setting a new standard for attendance management, leading the way to a future where operational efficiency and exceptional user experience are paramount.

Recognizing these pressing challenges, our research's primary objective is not merely to offer a digital alternative but to ensure that the proposed solution is deeply aligned with the user's needs and the modern digital era. The aspiration is to design a mobile-first, user-centric Sabbath School digital attendance system that transcends the confines of traditional methods. A system that is agile, intuitive, and responsive to the dynamic requirements of today's users, especially within the vibrant academic and religious community of Universitas Advent Indonesia. Through this endeavor, we aim to set a new benchmark in attendance tracking, heralding a future where efficiency and user experience are at the forefront.
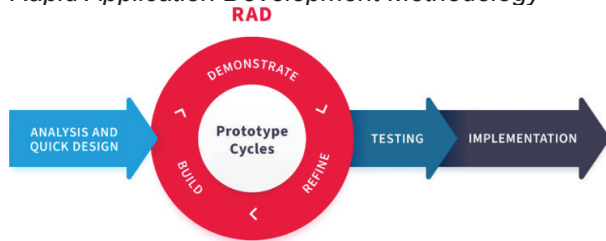
## Methodology
### Application Development

Figure 1 illustrates the iterative and dynamic Rapid Application Development (RAD) process (Bonar, 2021). This was utilized in the creation of

the UNAI Sabbath School Attendance System. The RAD model facilitated a quick and responsive development environment that enabled the team to align closely with end-user requirements while simultaneously allowing for continuous refinement of the system through successive iterations (Martin, 1991).

**Figure 1**

*Rapid Application Development Methodology*



This RAD cycle diagram underscores the adaptability and efficiency of the development process, highlighting the effectiveness of iterative design in delivering a tailored attendance system. The methodology proved to be integral to achieving the significant improvements in user satisfaction and operational efficiency reported in our research findings. The following are the key steps in using RAD.

o **Analysis and Quick Design:** The initial phase in our RAD approach involved a brief analysis, which led to the establishment of a foundational design. Here, we identified key user needs and system requirements specific to the Universitas Advent Indonesia setting. This stage laid the groundwork for developing the first prototype of the attendance system, emphasizing mobile-first and user-centric design principles.

o **Prototype Cycles (Build, Demonstrate, Refine):** At the heart of the RAD model are the prototype cycles. Through these cycles, we built successive versions of the system, each informed by user feedback and performance analysis. These cycles involved:

o **Build:** constructing incremental prototypes that incorporated functionality required for the system, which included managing attendance records, reporting, meeting scheduling, and group management.

o Demonstrate: presenting these prototypes to users to gather insights and to validate the design against user experiences and expectations.

o Refine: refining the system based on feedback, which included enhancing the user interface, improving data handling, and ensuring that the application's responsiveness met the needs of a mobile-first approach.

o **Testing:** Following the prototype cycles, comprehensive testing was conducted to ensure the reliability and stability of the system. This phase focused on identifying and rectifying defects, optimizing performance, and verifying that the application met the prescribed functional and non-functional requirements.

o **Implementation:** The final phase involved deploying the fully developed attendance system into the operational environment of Universitas Advent Indonesia. Implementation was the culmination of the RAD cycles, delivering a robust and user-friendly digital solution that effectively replaced the obsolete paper-based attendance tracking.

**Application Design**

Figure 2 is an outline of the functionalities that the UNAI Sabbath School Attendance System offers to administrators. This Use Case Diagram encapsulates the system's interactions with the administrative users, highlighting the mobile-first, user-centric design approach adopted in its development.

**Figure 2**

*Use Case Diagram of the Proposed System*
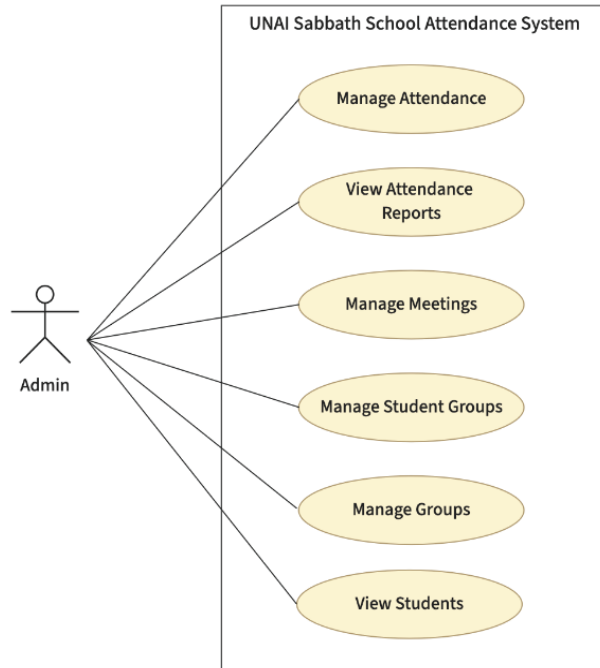


It defines the scope of operations that the admin can perform, which are critical to the digital transformation of attendance management processes within Universitas Advent Indonesia. These processes include the following:

o   **Manage Attendance:** This functionality equips administrators with the ability to log and modify the attendance records of students. It supports the dynamic nature of attendance statuses, facilitating administrators to mark attendance with multiple descriptors like present, absent, excused, late, or sick, thus mirroring the system's capacity for comprehensive status tracking.

o   **View Attendance Reports:** The system empowers administrators with the capability to generate detailed reports on attendance. These can range from summaries of attendance over selected meetings and groups, to detailed individual student attendance histories, enabling administrators to extract data-driven insights for academic and administrative purposes.

o   **Manage Meetings:** Administrators can utilize this function to organize, schedule, and maintain records of various school meetings where attendance needs to be documented. This feature is essential for the planning and execution of school schedules, ensuring that attendance tracking is seamlessly integrated into the institutional framework.

o   **Manage Student Groups:** The administrator has the capacity to define and oversee student groups, which are instrumental for assigning students into different groups. This function is indispensable for organizing the student body into manageable subsets, a feature that resonates with the system's focus on user-centric design.

o   **Manage Groups:** This function is narrowly tailored to the administration of groups specifically within the context of the attendance application. It allows for the management of groups, facilitating a structured approach to attendance administration, where groups are exclusively defined for attendance purposes rather than broader institutional organizational needs.

o   **View Students:** Providing a comprehensive overview, this feature allows administrators to access a detailed view of student profiles, encompassing their academic and attendance information. This is the cornerstone of functionality for maintaining up-to-date and accurate student attendance records.

The functionalities detailed in this use case diagram are reflective of the system's agile framework and iterative development lifecycle, underscoring its robustness and scalability. The diagram supports the research findings detailed in the paper, specifically the enhancements in efficiency and user engagement achieved by the system over traditional paper-based methods. It illustrates the system's potential applicability in varied settings, signifying its role as a transformative tool for attendance management within the educational sector.

In alignment with contemporary practices of leveraging agile and user-centric methodologies, our study delves into the creation of a tailored digital solution — a Sabbath School Digital Attendance System for Universitas Advent Indonesia. The impetus for this innovation stemmed from the imperative to transcend the limitations of antiquated paper-based attendance systems, which are notably inefficient and environmentally unsustainable.

Figure 3 shows the architecture of the system is encapsulated in an Entity-Relationship Diagram (ERD) that serves as the backbone of a meticulously designed single-page application (SPA). This SPA is meticulously optimized for mobile devices, ensuring expedited load times and fostering uninterrupted user engagement without the necessity of page refreshes. The ERD outlines the following components:

**Entities and Attributes:**
o   **Admin:** Reflects system administrators with credentials to oversee and manage the system.
o   **Students:** Encompasses details pertinent to the students, including their attendance statuses.
o   **Groups:** Defines various congregations such as study groups, with attributes that allow for identification and organization.
o   **Student Group:** Functions as a connective entity that links students with multiple groups, catering to the dynamic associations within the university community.
o   **Meeting:** Represents the scheduled academic congregations, integral to the system for monitoring attendance.
o   **Student Attendance:** Serves as a record for each student's participation in meetings, enhanced with diverse status labels as per our SPA's capabilities.
o   **Academic Year:** Delineates the academic periods, crucial for organizing and contextualizing the attendance data.

**Figure 3**
*Entity Relationship Diagram of the Proposed Application*
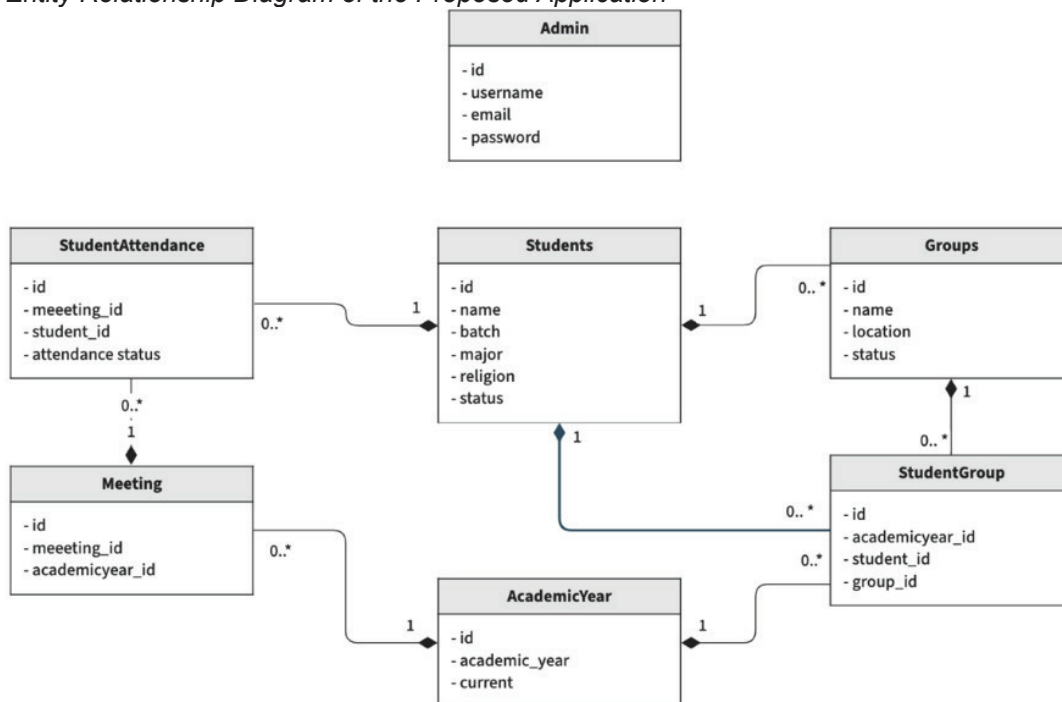
Through the application of Rapid Application Development (RAD) principles and iterative development cycles, this system is underpinned by a robust API that guarantees seamless integration and dependable data management. The result is a digital system that eclipses its paper-based predecessor in terms of efficiency, user satisfaction, and environmental consciousness. This diagram not only represents the logical structure of our SPA but also encapsulates the innovation and foresight that underlie our design—aa design that not only serves the immediate needs of Universitas Advent Indonesia but also possesses the adaptability to be implemented in broader community contexts, such as churches.

In essence, the ERD is a visual testament to the scalable, flexible, and efficient framework that our research proposes. It underpins a system poised to revolutionize attendance tracking and management in educational and potentially wider community settings. Future research is envisaged to explore the multifaceted applications of this digital tool, thereby enhancing institutional capabilities in the digital era.

## Results and Discussion

Figure 4 presents a triptych of screenshots from the UNAI Sabbath School's digital attendance management system as accessed on a mobile device. These screenshots highlight the user interface's transition from the initial login screen to the core functionality dashboard and navigation menu, reflecting the system's seamless user journey.

**Figure 4**

*Digital Attendance System Accessed Using a Mobile Device*
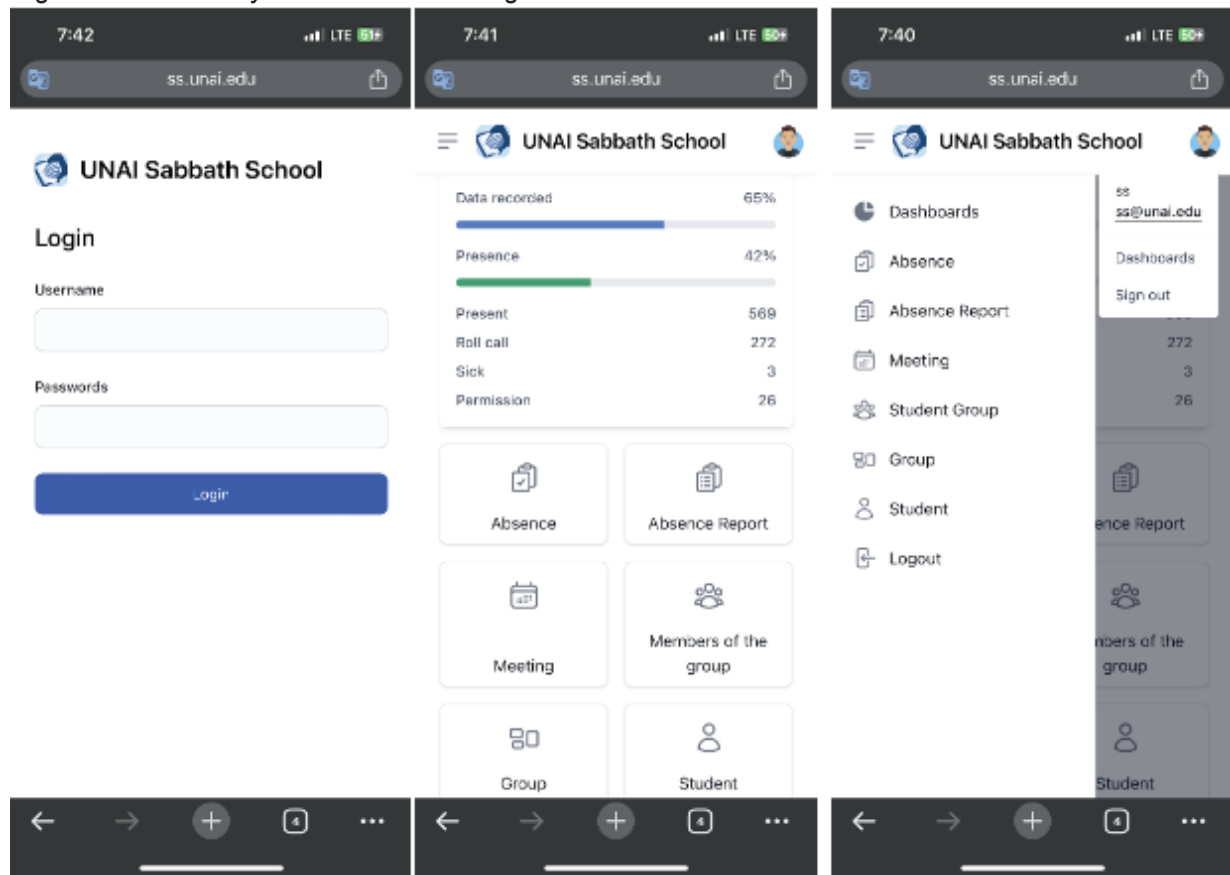
The first screen on the left demonstrates the mobile adaptation of the login page, maintaining the clean and intuitive design principles noted in the desktop version. It is optimized for mobile access with the necessary fields—username and password—arranged for ease of data entry on touchscreen devices. The blue login button remains prominent, facilitating a straightforward user action.

Centered is the dashboard interface, which gives a summary of attendance data in real time. The progress bar at the top suggests a dynamic tracking feature, perhaps indicating the proportion of attendance data captured versus the total expected entries. Below, a categorical breakdown provides quick insights into attendance status with quantitative metrics—numbers for 'Present,' 'Roll call,' 'Sick,' and 'Permission'— giving an immediate sense of current and cumulative attendance statuses. This page is an example of effective data visualization, offering at-a-glance information that aligns with the research's emphasis on improved efficiency.

The third screen on the right reveals an overlay navigation menu that extends from the dashboard. This menu structure presumably enables users to delve deeper into the system's features, such as detailed reports ('Absence Report'), group management ('Meeting', 'Student Group'), and profile management ('Sign Out'). The design consistency across the menu integrates well with the rest of the interface, maintaining user experience coherence.

**Figure 5**

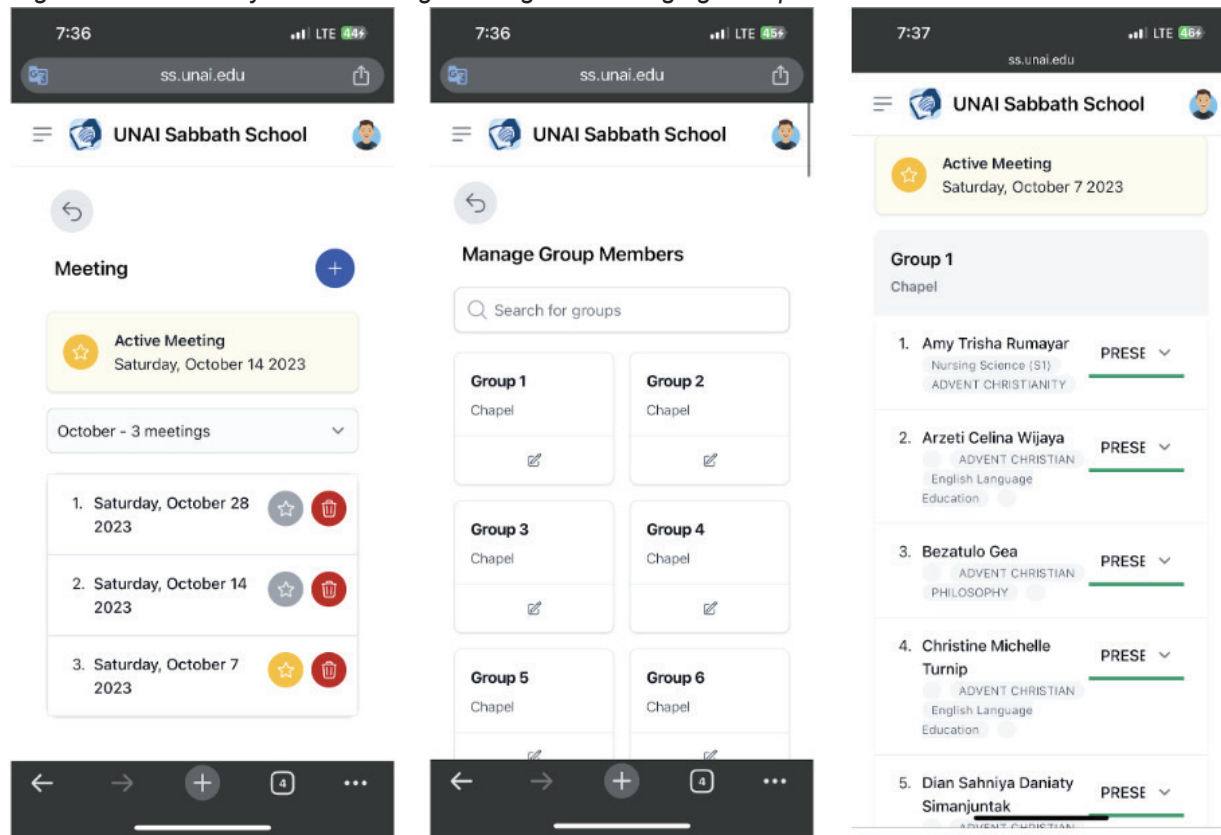*Digital Attendance System – Setting Meeting and Managing Group Members*

Figure 5 shows three screenshots of the developed digital attendance system. This image on the left displays the main attendance interface, where users can view and manage meetings. The "active meeting" highlighted indicates an ongoing session for the Sabbath School on October 14, 2023. Below the active session, a drop-down menu allows users to review past meetings within the chosen month, with individual sessions listed and marked with icons denoting their status—indicative of the real-time tracking capabilities of the system.

The second image illustrates the group management dashboard within the application. The interface shows an organized layout where users can navigate between different groups, labeled Group 1 through Group 6. Each group is associated with a location, specified here as "Chapel," which suggests that the system supports multiple meeting locations. The edit icons signify the system's streamlined group management feature, allowing for easy modification and organization of group details.

The final image provides a detailed view of the attendance tracking for a specific group, "Group 1." It enumerates individual participants, displaying their names, respective fields of study, and religious denominations. Each member's attendance status is marked as "present," shown by the tag "PRESENT," which is part of the versatile status categories feature. This level of detail in tracking underscores the system's capability to handle intricate attendance records, providing a comprehensive understanding of student engagement.

**Figure 6**

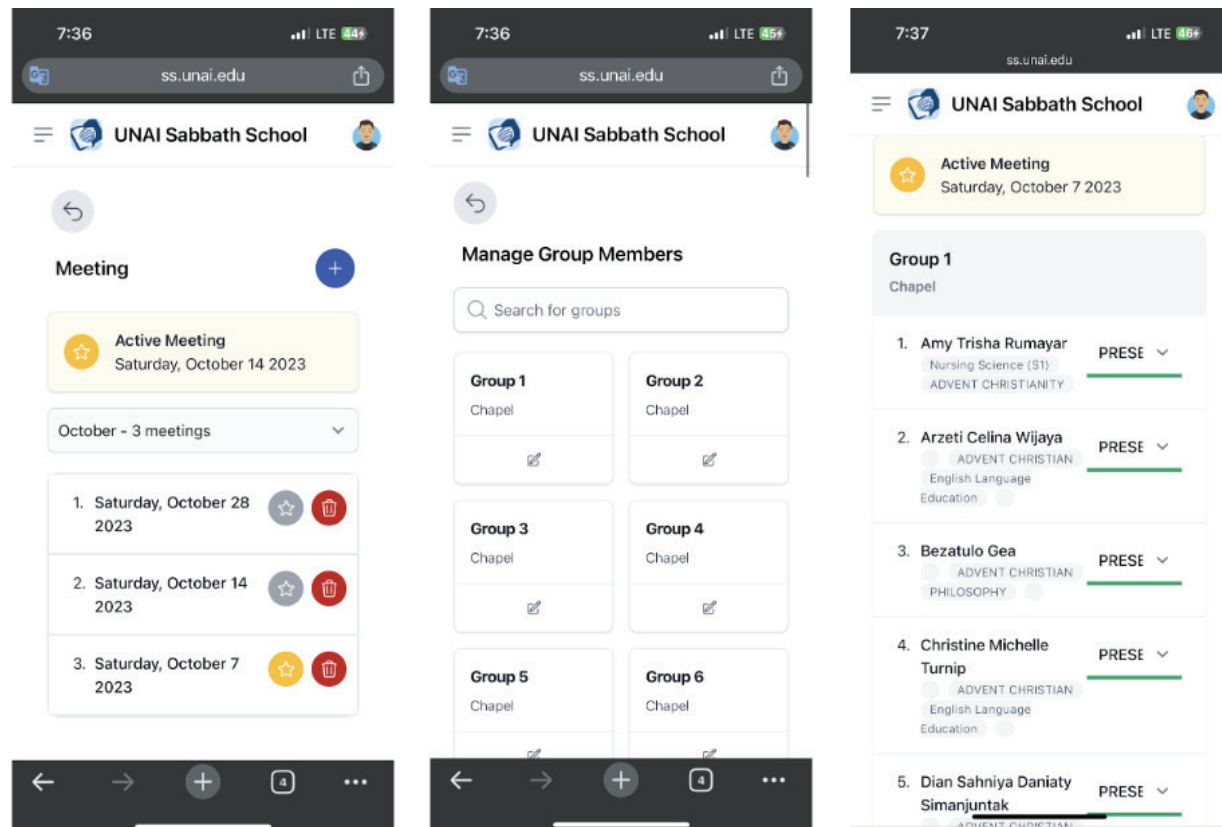*Reporting Features of the Sabbath School Digital Attendance System*

Figure 6 showcases the reporting features of the Sabbath School Digital Attendance System, demonstrating the application's capacity for generating comprehensive attendance reports. The system provides an extensive analysis of attendance data, allowing for efficient monitoring and management of student presence across various groups and meetings.

The first image displays the absence reporting module, which serves as a hub for generating different types of attendance reports: group attendance reports,meeting attendance reports, and student attendance reports. Each option is represented by an icon, offering a simplified path for users to access detailed attendance analytics. This modularity is crucial for tailoring reports to specific administrative needs and showcases the system's flexibility.

The second screenshot details the Group Attendance Report interface. It allows users to search for and select specific groups to view their attendance statistics. For instance, "Group 1" is displayed with a presence rate of 95.65%, accompanied by a numerical and visual representation of attendance data (present, roll call, sick, permission). The "View details" link suggests additional layers of data accessible for deeper insights, reinforcing the system's comprehensive tracking and reporting capabilities.

The final screenshot zooms further into the detailed attendance metrics for various groups, sorted by presence in descending order. It illustrates the user-friendly visualization of attendance rates, such as the 100% presence rate for "Group 40," with a breakdown of the status categories (present, roll call, sick, permission). This granularity not only provides immediate visibility into attendance health but also allows for quick assessments and interventions by educators and administrators. The presence of a "View details" option suggests further drill-down capabilities into more granular attendance data.

Collectively, these interfaces underscore the system's commitment to a user-friendly and efficient digital solution for attendance management. The continuity in design across different operational stages of the system demonstrates a thoughtful approach to user interaction, optimizing the experience for performance on mobile devices. This approach contributes to the user satisfaction and efficiency improvements outlined in the research paper.

**Conclusion and Recommendation**

This study provides substantial evidence that the implementation of a digital attendance system heralds a significant advancement in operational efficiency for educational institutions. The digitization process has led to a pronounced reduction in time and labor that was once the hallmark of manual attendance methods.

The tangible improvements demonstrated by this study offer a solid base for the validity of our research. Operational indicators, such as enhanced efficiency and reduced errors, have been tangibly improved and quantified, providing definitive proof of the system's effectiveness. These findings are in harmony with our initial research goals and theoretical predictions, thereby reinforcing the validity of our hypotheses and contributing valuable insights to the literature on digital transformation in attendance management.

Furthermore, the digital system's flexibility and scalability stand out as pivotal benefits. The positive outcomes at Universitas Advent Indonesia suggest that this system holds promise for widespread adoption. Its design allows for easy customization to fit diverse educational settings, paving the way for a potential overhaul in how attendance is managed across various institutions.

Concluding, the UNAI Sabbath School Attendance System exemplifies the potential of digital approaches in streamlining educational administration. This successful realization of the project's objectives not only affirms the

system's effectiveness but also encourages its consideration as a model for similar educational environments.

For future research, it is recommended that the scope of the Sabbath School Attendance System's application be expanded to the global Seventh-day Adventist Church network. Investigating its adaptability and impact across different cultures and administrative structures would provide valuable data. This could lead to a unified, efficient attendance management system that enhances engagement and operational excellence for the Adventist Church worldwide.

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