Development of Attendance Tracking System for Enhanced Efficiency: Sukaina Bint AL Hussein High School Case Study

Shaikha Alfalasi
College of Technological Innovation
CTI
Zayed University
Dubai, United Arab Emirates
201909365@zu.ac.ae

Sara Almarzooqi
College of Technological Innovation
CTI
Zayed University
Dubai, United Arab Emirates
2020000558@zu.ac.ae

Hamda Ali
College of Technological Innovation
CTI
Zayed University
Dubai, United Arab Emirates
201806808@zu.ac.ae

Dina Tbaishat
College of Technological Innovation
CTI
Zayed University
Dubai, United Arab Emirates
Dina.Tbaishat@zu.ac.ae

2024 International Conference on Computer and Applications (ICCA) | 979-8-3503-6756-0/24/$31.00 ©2024 IEEE | DOI: 10.1109/ICCA62237.2024.10928050

***Abstract*—Recording students' attendance manually in schools can lead to inaccuracies that compromise time efficiency and overall effectiveness of the attendance tracking process. This project tackles the issues and challenges that Sukaina Bint Alhussein High School in UAE deal with when using their manual attendance system. The proposed system in this project is tailored specifically for the selected school to automate the attendance process, a key aspect of our project involves the implementation of a dynamic real-time dashboard using Power BI, providing a user-friendly interface that further elevates the effectiveness of attendance tracking within the school environment. The system developed is now being used at the school.**

Keywords—attendance tracking, dashboard, power BI, automation, student attendance.

I. Introduction

The main objective of this work is to design and develop automated attendance tracking system that addresses the drawbacks of manual attendance recording. The system is developed specifically to meet the needs of Sukaina 'BintAlhussein' high school in United Arab Emirates (UAE). Through the integration of technology, and by leveraging the power of advanced tools attendance tracking is revolutionized at the selected school, eliminating inaccuracies and enhancing overall system efficiency. Not only do we meet the immediate needs of the selected school, but also set a standard for superior attendance management systems across educational institutions. A key aspect of our project involves the implementation of a dynamic dashboard using Power BI, providing a user-friendly interface that further elevates the effectiveness of attendance tracking within the school environment.

Students' attendance at Sukaina Bint Al Hussein High school has been recorded manually. Manual attendance systems are prone to a vast number of inaccuracies that compromise the accuracy, time efficiency and overall effectiveness of the attendance tracking process due to the absence of certain features hindering the potential efficiency. Therefore, there is an obvious pressing need for the design and implementation of an enhanced automated attendance tracking system to overcome these challenges. We hope that our proposed dashboard for attendance tracking can help meet the needs of our target audience. Our target audience is school staff that are responsible for attendance tracking but also students and parents who are directly impacted by the system's accuracy and efficiency.

A lot of work has been done and introduced in the literature in relation to automating the process of taking attendance in schools. [1] presents multiple technologies used in the development of attendance tracking systems with providing examples of existing student attendance tracking systems, the paper also defines criteria for performance evaluation of the technologies employed, and finally it evaluates those technologies and highlight challenges associated with manual attendance recording in educational institutions. The authors considered three perspectives for the evaluation, firstly the educational institution management, second, the teachers' viewpoint, and lastly the engineers' viewpoint. The criteria are very crucial for the design and development of an attendance system which is valuable for our senior project. It also takes into consideration the financial, managerial, and technical aspects of implementing the system. The criteria that were deemed important for the management team and teaching staff included cost (purchase/implementation cost and operating/maintenance cost), security to prevent absent students being falsely registered, data safety to eliminate unauthorized access and data loss, accuracy, speed, and simplicity of use and customizability. After careful consideration of the evaluation of the criteria of each technology as well as issues of current technologies, a web-based attendance system was proposed.

II. Literature Review

The literature review delves into the issues that stem from manual attendance systems. It covers technologies that have emerged that can help the evolution of attendance systems. Solutions are proposed as well as discussions about the design and implementation of dashboards to ease the management of attendance. Overall, the importance and need to transform to

a more digitized attendance system is revealed through the literature.

The paper also refers to the integration of different technologies; RFID, biometrics, QR barcodes and mobile based attendance management systems. RFID uses tags for the recording of attendance and ensures accuracy. Biometric attendance systems rely on fingerprint verification for precise accuracy as well. QR codes allows faculty and students to scan their individual QR codes which prevents misuse and increases security. Mobile-based attendance management systems rely on smartphone applications and enhance the communication between teachers and students. The web-based system relies on a local network and students would register their attendance through a web interface on their device. The proposed system advocates for the use of free and open-source technologies, such as Linux OS, HTML5, PHP scripting, MySQL database engine, and Apache web server [1]. Operating on the local network provides advantages regarding security and data safety. This study aided in the understanding of what goes into developing a system and it also emphasized the importance of a more efficient web-based system for tracking attendance although there lacked further exploration of user experience and the functionality of the proposed system it mainly focused on the functionality of certain technologies.

Another paper found discussing the transformation of students' attendance records in schools [2]. The study attempts to unveil insights with student attendance data in "digitally mediated" education. It explores how data is recorded and handled in three different schools in Melbourne. Each school collects data in a different way including paper-based, computer-based, and iPad-operated technology. The researchers collected data through site visits, interviews, and observations. Overall, the paper stated that there is a lack of "centralized and user-friendly" platforms which overall hindered schools from handling attendance data properly. The findings of this paper suggest a more accessible platform to unlock the full potential of attendance data to enhance students' engagement and wellbeing. The findings also stress the importance of investing in user-friendly data infrastructure, teacher training, contextualized data use, addressing inconsistencies, and technological integration to enhance data practices in schools. In another work, the recording, reporting and use of attendance records in schools in Australia was investigated [3]. The article highlighted the evolution of attendance data from just being for administrative purposes to a key performance indicator. The first section of this paper combines document analysis exploring the role of ACARA and MySchool website in enhancing the transparency of attendance tracking. Secondly, the paper discusses the guidelines offered by the national standards for student attendance where attendance is categorized as part-day or whole data. This work recognizes the need for constant change and having an agile system that responds to constant change, especially after COVID-19 the educational landscape is changed.

As mentioned previously, the manual way of monitoring attendance is inefficient, and therefore the implementation of dashboards to monitor and manage students' attendance was discussed in [4]. Dashboards allow teachers to easily track students' attendance, they are effective and efficient because all data is consolidated into a single screen and makes keeping track of day-to-day activities seamless for staff. This article provided insights about the elements of a well-designed dashboard, including simplicity, minimal distractions, organization, good communication and visual appealing interface allowing users to drill down for detailed information, as quoted from the paper: "*the interface allows lecturers to select the course, section, and absent type, displaying data visually for quick comprehension*" [4]. The key components in the proposed dashboard include individual attendance indicator, absence rate information, and weekly summary graph, summary of absence reasons, course, and section selection as well as the implementation of early "warning systems" and the issuing warnings which is a proactive way to address attendance policy violations

III. Methodology

The selected development model for the project is the agile methodology. Agile methodology is iterative and flexible in nature, it aligns with the project's user-centered design approach and the need for continuous user feedback. Adaptability to changing requirements and its emphasis on delivering increments of value to users. Agile methodology involves the following phases:

- *Plan*: In the planning stage of the project, the problem must be identified, in addition to key objectives, and priorities based on the user needs. To collect the required data, the following methods were used to identify the requirements: interviews, where an interview with the administration of the school was conducted, and investigating current systems in the literature and relevant technologies.
- *Design*: The design phase begins once all the data is collected, and requirements are finalized, allowing for multiple revisions though first developing a robust database schema to store attendance data securely. Second, integration with Power BI and establishing a real-time data visualization.
- *Develop*: Implement the design elements into a functional layout. This step involved using power BI. Agile development practices such as iterative development and continuous integration were applied to deliver incremental updates. The development phase embraced the creation of an initial prototype with basic functionality for attendance tracking. Followed full attendance tracking system development incorporating feedback and additional features as they emerge from the stakeholder's side.
- *Test*: The testing phase is crucial to evaluate the functionality and user experience. As well as gaining user feedback at each increment, to address any issues. This involved collecting feedback from school staff and administrators to refine the prototype.
- *Deploy*: This stage of agile methodology involved making the developed product available for use by end-users/ stakeholders. The product can be utilized and to ensure it meets quality standards and is ready to be launched.
- *Review*: An important phase is the review phase. Gathering feedback is important for the overall success of the product as multiple issues can be revised and therefore improved based on suggestions and feedback. Iterative Feedback encourages continuous

feedback from end-users for ongoing improvements. Moreover, staying informed about software updates is essential.

- *Launch*: This phase involves launching the final dashboard. The selected school is currently using the developed tracking system.

IV. Discussion

After The requirements defined for developing this system include the following:

- *Launch*: This phase involves launching the final dashboard. The selected school is currently using the developed tracking system.
- *Hardware Requirements*: Sufficient server capacity to handle data storage and processing. Reliable network infrastructure to support communication between devices and the central server. Workstations for staff, equipped with modern browsers for accessing the dashboard.
- *Software Requirements*: Database Management System (DBMS) for storing and retrieving attendance data. Web server software for hosting the dashboard application. Dashboard application software tailored for attendance tracking. Operating system compatible with the chosen server and database technologies.
- *Security Features*: User authentication and authorization mechanisms to control access based on roles (admin, teacher, and parent). Encryption protocols to secure data transmission between the dashboard and users. Regular security updates and patches to address vulnerabilities.
- *Compatibility*: Cross-browser compatibility to ensure the dashboard works seamlessly on various web browsers. Mobile responsiveness for access on different devices (smartphones, tablets).
- *Scalability*: The ability to scale the system to accommodate an increasing number of users and attendance data over time.
- *Integration*: Compatibility with existing school management systems or other relevant software. APIs (Application Programming Interfaces) for potential integration with third-party applications.
- *User Interface and Experience*: Intuitive and user-friendly interface for both staff and parents. Accessibility features to ensure usability for all users.
- *Data Backup and Recovery*: Regular automated backups of attendance data to prevent data loss. Mechanisms for quick data recovery in case of system failures.

In addition to the above non-functional requirements, the system should perform functional requirement that involve reporting and analytics; reporting tools for generating attendance reports and insights, and data visualization capabilities to present attendance trends and patterns.

Figure 1 below represents the basic old attendance system used at Sukaina High School, the whole process starts with the admin staff taking the attendance manually on paper, then when the attendance report is created from all sections, the admin reports manually to the Ministry of Education page, the principal of the school and the parents to inform them of the late comers and absents. Moreover, the staff takes attendance throughout the day for all classes and keeps records for administrative uses.

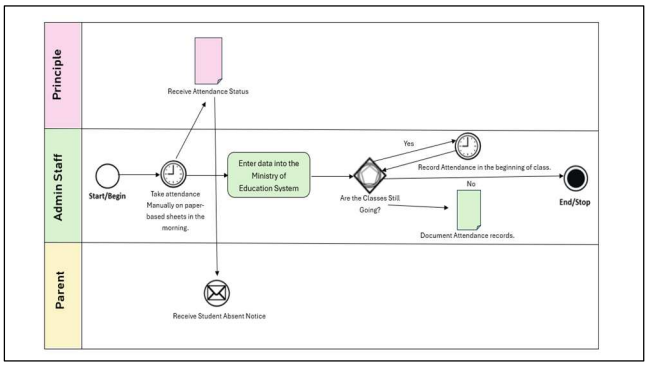

Fig. 1. Old System Business Model

On the other hand, Figure 2 presents an enhanced process model of the newly developed attendance system, starting with collecting data from the school system regarding the medical reports and transportation of students, followed by using them collectively with attendance taken by admin staff in an Excel report to be displayed all in 2 dashboards: dashboard 1 for attendance and lateness, dashboard 2 for medical conditions, sick leaves and transportation. Furthermore, the system will notify the parents of latecomers and absent students automatically with the principal of the school.

Keeping in mind that the school takes attendance for each class (7 classes a day) multiple times a day, and regularly updates the data on the system or a sheet for the school records manually is quite a time and energy-consuming, therefore the new attendance system will be handy as it will keep track with data in the attendance report and change automatically due to the changes on the excel sheet report.

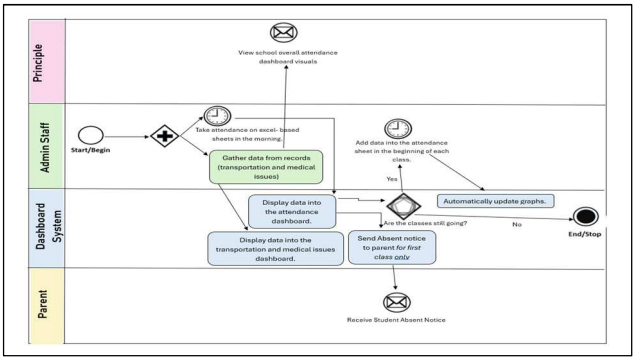

Fig. 2. New System Business Model.

V. Results

The This section visualizes the dashboard developed, highlighting the key functionalities implemented. Starting with Figure 3, the opening page is displayed showing the main option for accessing different pages, these are: attendance summary, students' statistics and alerts and reminders.

Following selecting the desired option, a list of classes will be presented as shown in Figure 4.

Fig. 3. Main Menu – the opening screen.

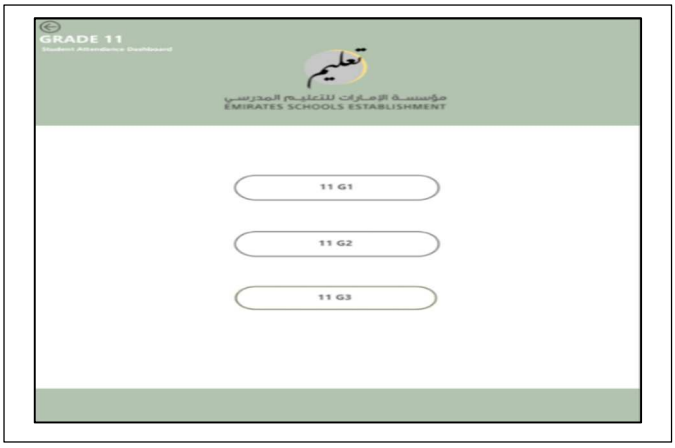

Fig. 4. Class section page.

Figure 5 is the student's attendance summary page that is composed of different graphs. A filtering option is available allowing teachers to find the precise information they are looking for according to the day of the week, the student, or the period, facilitating easy and prompt information retrieval.

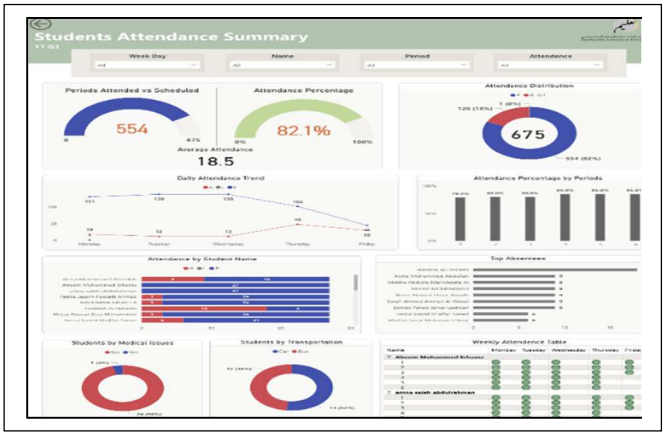

Fig. 5. Student Attendance Summary Dashboard.

As can be seen in Figure 5, multiple graphs are generated for better data visualization, these are summarized in the next table:

TABLE I. JUSTIFICATION FOR THE USE OF VARIOUS CHARTS

Visualization	Justification	Use in the dashboard
Gauge chart	Effective at showing progress of performance especially percentages	Attendance percentage Periods attended compared to scheduled
Donut chart	Effective at visualizing percentages of different categories	Attendance distribution Students who have medical issues Students and their transportation
Line chart	Effective at visualizing trends overtime and patterns	Daily attendance trends
Clustered column chart	Ideal for comparing values across categories	Attendance percentage by periods
Stacked bar chart	Ideal for displaying the contribution of each subcategory to the whole	Attendance by student name
Clustered bar chart	Ideal for comparing values across categories	Top Absentees
Matrix table	Displays multidimensional data in a compact way	Weekly attendance table
Cards	Simple visualization of single values	- Medical issues - Transportation

The individual student attendance insight is a more drilled-down version including more information such as individual statistics and transportation details which can be depicted in Figure 6.

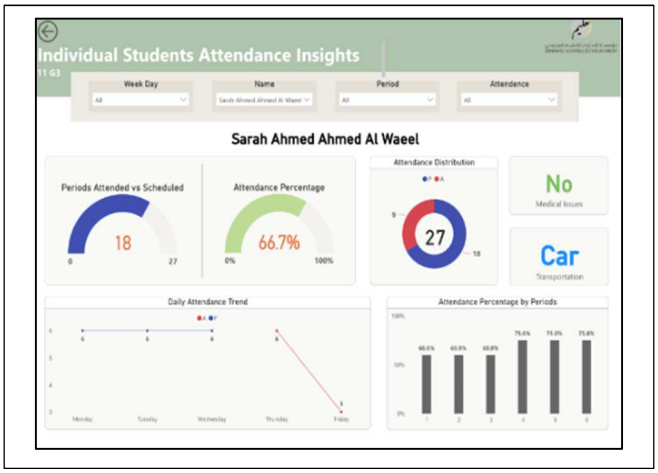

Fig. 6. Individual Attendance Insight.

Finally, a page was developed for staff to post reminders and updates resembling a bulletin board, as depicted in Figure 7 given below.

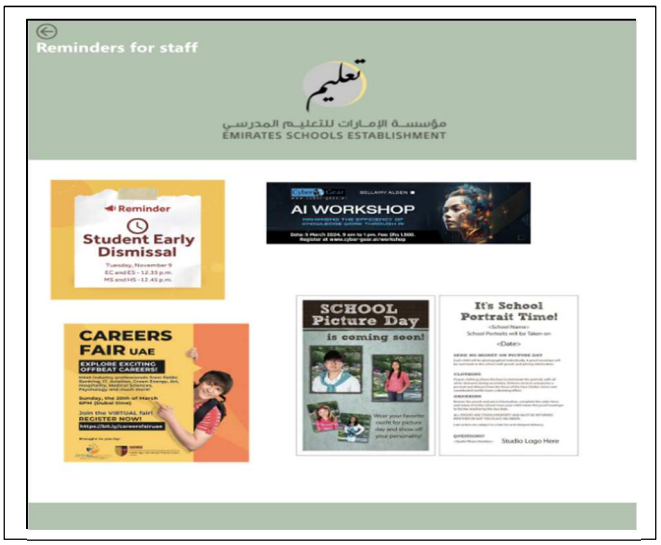

Fig. 7. Alerts and Reminders

VI. Evaluation of the System

A point of contact from the high school was supporting us throughout the project. Communication was important to make sure requirements and user needs were met. Feedback was gathered incrementally as we were developing the dashboard. Improvements were made from the given feedback and that resulted in the final dashboard that satisfied their needs. The project objectives were evaluated based on the results of the tests. Through this evolution process, we successfully met the majority of our project objectives which ensures that the proposed dashboard is effective in meeting the needs for curating a more efficient attendance tracking system for Sukaina Bint Al Hussein High School. To test and evaluate the project, multiple tests were conducted, these are:

- *Functionality tests*: Ensuring all dashboard features are functionally correct.
- *Data Validation tests*: Making sure all the data displayed are accurate and consistent.
- *Usability tests*: Conducting incremental user testing with teachers to assess the dashboard's ease of use and to gather feedback.
- *Integration tests*: Ensure compatibility with existing infrastructure.
- *Compatibility tests*: Testing dashboard compatibility with different web browsers and devices
- *User acceptance tests*: Inviting users to participate is UAT to evaluate suitability for their needs and gather any feedback on overall satisfaction.

The implementation of a new attendance tracking system addresses various challenges that the manual attendance systems exhibit. The new system offers more efficiency, and reduces the time and effort. The newly developed dashboard offers real time data integration, data visualization and reports generation using PowerBI.

This transition simplifies the process of recording students' attendance. The availability of instant real-time data of attendance addresses potential problems that student's face which will in turn contribute to improved student academic performance.

VII. Conclusion and Future Work

The primary objective of this project was to develop a comprehensive school attendance dashboard using data analysis tools to clean and organize data in Excel, followed by the implementation of Power BI for data visualization and dashboard creation. The project can be deemed successful based on several factors. Firstly, the utilization of data analysis tools in Excel significantly improved the quality and reliability of the attendance data. Secondly, the implementation of Power BI facilitated the creation of dynamic and user-friendly dashboards that effectively represent attendance trends and patterns. Lastly, the project adhered to the established objectives, timelines, and quality standards, demonstrating effective project management and collaboration among team members. While the current system boasts real-time updated attendance data, includes advanced analytical capabilities, enhanced visualization and reporting, and integration with additional data sources, there are still avenues for further enhancement and expansion.

- *Mobile Accessibility*: Develop a mobile application or responsive web interface for the attendance dashboard, allowing stakeholders to access real-time attendance data anytime, anywhere. This would improve accessibility and convenience for users, particularly teachers and parents.
- *Feedback Mechanism*: Implement a feedback mechanism within the dashboard to gather input from users and continuously improve the system based on their needs and preferences. Ensuring that the system remains relevant and valuable over time.
- *Cross-Institutional Collaboration*: Explore opportunities for cross-institutional collaboration by enabling the sharing of anonymized attendance data between schools or districts. This collaborative approach fosters data-driven decision-making at a broader scale and facilitates benchmarking against peer institutions.
- *Integration with Learning Management Systems (LMS)*: To provide a comprehensive overview of student engagement and attendance alongside academic coursework and progress. This integration offers educators and administrators a unified platform to monitor and support student success.

Acknowledgment

The authors would like to thank Zayed University for supporting and funding this project.

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