



Kolumbano i-Leave: Online Leave Management System with Trends using Data Visualization

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ABSTRACT

Human Resources (HR) plays a vital role in overseeing recruitment, training, and employee benefits, ensuring organizations adapt to changing business requirements while maintaining workforce productivity. Among its responsibilities, HR manages employee records, including the monitoring of leave availability, which requires skilled personnel. This study developed a web-based system to manage employees' leave benefits, categorized into two types: Statutory Leave and Institutional Leave. Statutory Leave refers to leave types mandated by law, such as maternity or paternity leave, while Institutional Leave is determined by the organization, such as academic or professional development leave. The system incorporated a multi-level approval process tailored to an academic setting. For leave applications, teachers required approval from their Dean before HR finalizes the request, while sick leave passes through the clinic for notation before HR approval. Non-teaching staff followed a similar process with their immediate department Unit Heads. Deans and Unit Heads followed the same process, with their respective Vice Presidents approving regular leave and the clinic noting sick leave before HR's finalization. Additionally, the system leveraged data visualization tools to monitor leave availability and trends, providing valuable insights for unit heads. These features enhanced transparency, operational efficiency, and employee satisfaction. Testing outcomes validated the system's reliability, usability, and scalability, achieving an average of 94.26% for non-functional requirements and 100% for functional requirements, surpassing acceptable performance standards. Future recommendations included the development of a mobile application to improve portability and implementation.

Key Words: Academic settings, Data Visualization, Efficiency, employee Benefits, Employee satisfaction, Human Resources, Leave Management System.

1. INTRODUCTION

This study explores the potential of internet-based leave management systems to enhance the understanding of employee absenteeism trends through effective data visualization. By leveraging advanced visualization techniques, these systems help organizations identify key patterns, such as the timing and frequency of leave periods, enabling institutions to strategically allocate resources, maintaining operational efficiency [6]. Additionally, analyzing long-term absenteeism trends, including those related to employee retirements, equips organizations to better plan for workforce transitions. Integrating these insights facilitates streamlined leave management, informed decision-making, and improved employee satisfaction through equitable and transparent leave policies [2].

Manual leave application processes pose several challenges, particularly in educational settings. Late submission of leave forms can result in unexpected wage deductions or unpaid leave [7]. Furthermore, issues such as inaccuracies, misplaced documents, and delays in processing leave requests negatively affect employee morale and work-life balance [4]. Manual systems are prone to errors, excessive paperwork, and inefficiencies, emphasizing the need for automated solutions to enhance operational efficiency in Human Resource Development Office (HRDO). Adopting an online leave management system offers numerous advantages, including streamlined procedures, increased transparency in monitoring leave balances, and improved data visualization for strategic decision-making [5]. These systems also enable employees to access leave-related information remotely, ensuring compliance with labor regulations and reducing error rates [1]. Predictive systems like LightGBM can analyze and project employee leave trends, enabling institutions to manage staffing requirements proactively [3].

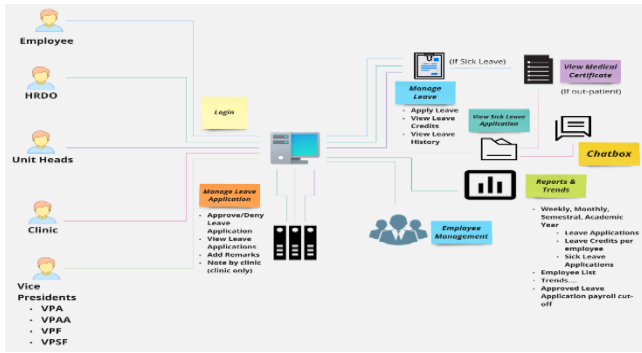


Figure 1: Product Perspective

Figure 1 illustrates the leave management system’s architecture, detailing its features and interactions with various stakeholders. Fortich and Marcial [3] emphasized that electronic leave systems improve synchronization and adherence to regulations, ultimately increasing employee satisfaction and productivity. The block diagram highlights the system’s functionalities and relationship with stakeholders, offering a comprehensive view of its operational structure

This research underscores the importance of efficient leave management systems in educational institutions. Transitioning from traditional manual methods to digital platforms enhances operational efficiency, transparency, and data-driven decision-making. Kumar, Naveen, and Nagammai [4] pointed out that such systems reduce paperwork, minimize workloads, and streamline faculty leave handling, notifications, and replacements. The proposed online leave management system addresses these needs, achieving an average performance rate of 98% for non-functional requirements, which exceeds the acceptable threshold. Future developments, such as incorporating a mobile application, would further enhance the system’s portability and implementation efficiency.

2. METHODOLOGY

2.1 Research design

This system was developed using the Agile process model, which has been adopted as a research approach due to its flexible, interactive, and collaborative nature. Unlike linear models, Agile emphasizes incremental development and continuous improvement, ensuring the system evolves in alignment with user needs and feedback.

In addition, the development of this system also adopted the IEEE (Institute of Electrical and Electronics Engineers) Recommendation in software engineering. This recommendation refers to a set of standards and best practices established by the IEEE for developing, documenting, and maintaining software projects. These recommendations cover various aspects of software engineering, including requirements analysis, design, coding, Testing, and documentation.

By adhering to IEEE guidelines, software engineers ensure that their projects are developed with high quality, reliability, and maintainability. These standards help promote consistency and interoperability in software development, enabling better collaboration among teams and improving the overall understanding of the system. Following IEEE software engineering recommendations enhances software products’ credibility and trustworthiness, benefiting developers and end-users.

The Agile process model adopted in this study involves a cyclical progression through six phases, as illustrated in Figure 2.



Figure 2: Process Model

3. RESULTS

The design and development of Kolumbano i-Leave: Online Leave Management System with Trends using Data Visualization utilizes and implements the Agile process model. Each phase is discussed below.

3.1 Review

Defining clear and comprehensive requirements played a vital role in developing the Kolumbano i-Leave: Online Leave Management System with Trends using Data Visualization. During this phase, the Group documented functional and non-functional requirements through meetings and consultations with the SCC HRDO, the primary client. Additional insights were gathered from respective Deans, Vice presidents, and clinic personnel, who act as key approvers for various leave applications. This phase ensured that the system’s features aligned with user needs, leave documentation, approval workflow, and Monitoring.

3.2 Planning

The planning phase played an important role in shaping the success of the Online Leave Management System with Trends Using Data Visualization. It served as the foundation for clearly defining and organizing the project’s objectives, requirements, and resources. This phase ensured the team had a clear roadmap for development.

The planning officially began on April 15, 2024, and concluded on April 26, 2024, spanning two weeks. During this time, the team held regular group meetings to brainstorm, align their goals, and establish a shared understanding of the project’s purpose and scope. These discussions created a Work Breakdown Structure (WBS) to break the project into smaller, manageable tasks, ensuring every step of the development process was accounted for.

The team also prepared detailed project documentation, which included the project summary, scope and objectives, and assumptions and constraints that might impact the project’s progress. Recognizing the importance of staying on track, the team developed a comprehensive schedule and budget plan to allocate resources efficiently. These documents became the team’s blueprint, outlining the steps and milestones to achieve.

To ensure a smooth workflow, specific roles and responsibilities were assigned to each team member. Plans for managing risks, controlling requirements, and maintaining quality were also implemented. The team prepared for potential challenges, knowing that changes might arise during development. Regular reviews were incorporated into the plan, allowing the team to adapt to new requirements and refine their approach when necessary.

The planning phase set the tone for the entire project, giving the team a sense of direction and purpose. By organizing their tasks, allocating resources effectively, and identifying potential risks, the team ensured they were prepared for the challenges ahead. This phase became a solid stepping stone, paving the way for the design, coding, and testing phases.

3.3 Design

The design phase played a crucial role in developing the overall structure and functionality of the **Kolumbano i-Leave: Online Leave Management System with Trends Using Data Visualization**. During the system development, the focus was on transforming the project’s requirements into a clear and organized system blueprint.

3.3.1 Technical Specification

The Online Leave Management System with Trends Using Data Visualization has several key components. First is a website portal where users integrate and access the system. The necessary hardware includes devices such as PCs, laptops, or smartphones. Employees act as end-users by submitting their leave applications through the system. Approvers, which consist of the respective deans, vice

presidents, and the clinic for noting sick leaves, are responsible for reviewing these applications. Finally, the HR Office serves as the primary administrator of the system, overseeing its operations and management. The following components also act as the fundamental building blocks of the system:

- HTML
- CSS
- PHP
- MySQL
- JavaScript
- Bootstrap

3.3.2 Use Case Diagram

A use case diagram illustrates the functional requirements and user interactions with a system from the perspective of its end users. Its primary aim is to provide a straightforward, high-level summary of how users interact with the system.

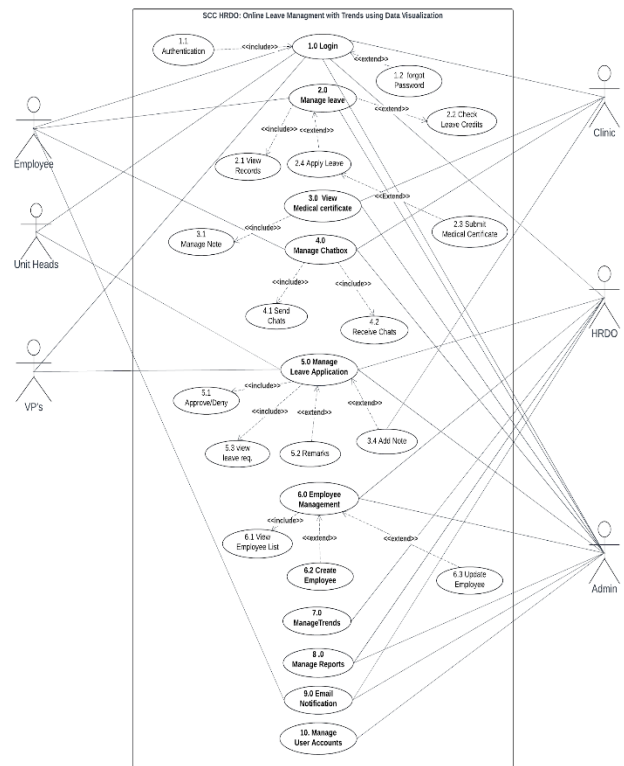


Figure 3: Use Case Diagram

Figure 3 outlines interactions within the web-based leave application system involving the Employee, Unit Head, Clinic, Vice Presidents, and the Human Resource Development Office (HRDO). The process starts when an Employee submits a leave application, which is routed to the appropriate approver, such as the Unit Head or VPAA, for evaluation. The approvers can approve or decline the application based on criteria, while the clinic records sick leave applications. The HRDO manages the overall

process, ensuring accurate record-keeping and leave status updates. The diagram effectively illustrates the system's workflow and user interactions.

3.3.3 Interface Design

Interface design plays a vital part in the system's development. It focuses on organizing visual components, such as buttons, input fields, and navigation menus, to optimize user interaction and improve the overall user experience. The main objective of interface design is to provide a smooth and user-friendly experience by ensuring the layout is clear and visually appealing. The design refers to a graphical user interface (GUI) that users interact with to perform tasks or access system features.

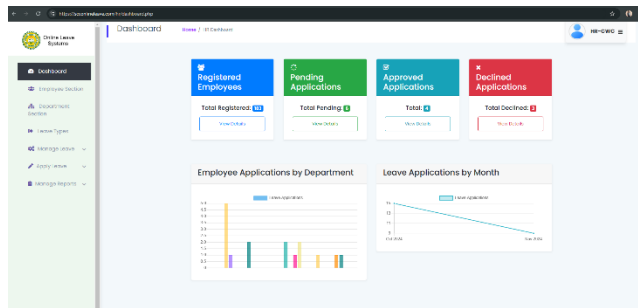


Figure 4: Data Visualization

Figure 4 illustrates the interface of the data visualization tool, which allows users to monitor, analyze, and respond to emerging trends. This interface typically includes features for visualizing data trends over time, setting alerts for specific trends, comparing historical data, and generating reports to support informed decision-making.

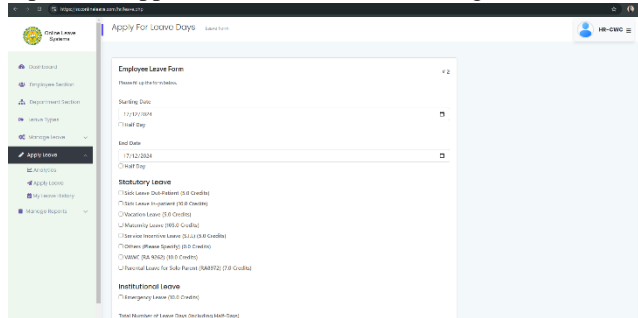


Figure 5: Leave Application Process

Figure 5 shows the leave application process interface to streamline and automate the leave request, approval, and management process for sub-employees. The workflow begins with employees submitting their leave requests through the interface. Once submitted, these requests are automatically routed to the appropriate supervisors for approval. After approval, the system updates the employee's leave balance and notifies relevant departments, ensuring that all records are current. This efficient workflow minimizes delays and enhances communication between employees and management

regarding leave management.

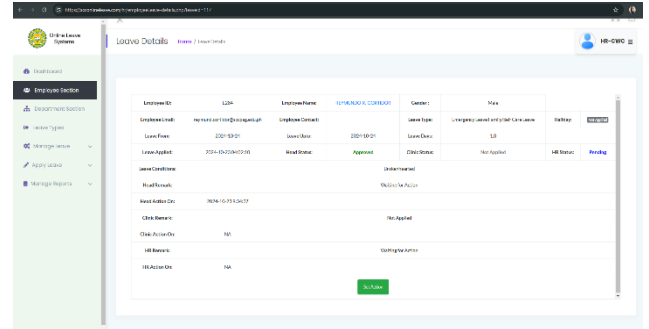


Figure 6: Manage Leave Request

Figure 6 demonstrates that the Manage Leave Request Interface effectively manages leave requests, adheres to company policies, and maintains accurate records, enhancing overall organizational productivity and employee satisfaction. Streamlining the leave process reduces the administrative burden on HR teams and allows employees to submit requests easily. This transparency fosters trust and ensures that all leave-related decisions are fair and consistent.

3.4 Development/ Implementation

During this phase, the system was constructed and coded. Following the planning and design phases, developers meticulously translated the detailed design specifications into functional code. This stage marked the tangible realization of the system's outlined functionalities and features.

As a web-based application, the development process utilized a robust combination of technologies, including HTML5, PHP, MySQL, JavaScript, Bootstrap, and CSS. These technologies served as the foundation for creating an intuitive and responsive user interface, ensuring seamless interaction for employees, managers, and approvers.

The system was designed and developed to streamline the leave application process while enhancing decision-making through data visualization tools. Key features included metrics for tracking total registered employees, approved applications, pending applications, and declined applications. Additionally, graphical trends showcased monthly leave applications and department-wise analysis, providing actionable insights for the SCC HR office and management.

The Online Leave Management System delivered a centralized, efficient, and data-driven solution tailored to the organization's needs by addressing inefficiencies in traditional leave management practices.

3.5 Testing

This phase, underwent rigorous testing to ensure its alignment with the established specifications from the planning and design phases. Comprehensive testing was conducted at various stages of development to identify and address potential issues consistently. This meticulous process ensured the system met high-quality standards, validating its functional requirements and performance.

The testing phase involved functionality validation, interaction capability tests, and feedback collection from simulated end-users. Results from the tests were highly positive, reflecting the system's robustness and efficiency. Factors such as bug absence, performance stability, and system logic were thoroughly evaluated. These results confirmed the readiness of the system for real-world deployment, ensuring it delivered a seamless and reliable user experience.

3.6 Deployment

The development phase marked the preparation of the system for integration into its target environment, specifically for the SCC HR office. This phase included user acceptance testing, during which end-users and IT experts conducted a thorough evaluation to ensure the system's functionality and reliability in real-world scenarios.

Following these evaluations, the findings were summarized, confirming that the system met all established acceptance criteria. The deployment process required careful planning, coordination with the HR office, and additional testing to ensure seamless integration into daily operations. Special attention was given to user onboarding, system configuration, and addressing any final adjustments.

With the system ready for implementation, it was positioned to transform the leave management process by providing a centralized, efficient, and data-driven solution tailored to the organization's needs.

4. CONCLUSION

In conclusion, the system yielded positive results in both functional and non-functional aspects. Key features, including Leave Application, Approval Process, Data Visualization, and Interaction Capability, demonstrated robust performance, stability, and security. The system's alignment with ISO 25010 standards ensured it excelled in functionality, reliability, usability, and maintainability.

The system's efficiency is evident in its paperless approach, centralized cloud-based data storage, and online accessibility, which streamlined the leave management process. Usability was prioritized by offering a user-friendly interface that facilitates smooth navigation for all users. While the system performed reliably and effectively, minor UI design and error handling improvements were identified as opportunities for further enhancement.

Overall, the successful implementation confirms the system's ability to address organizational leave management needs, provide a dependable user experience, and offer scalability for future enhancements.

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