

Enrollment Appraisal Using Rule-Based Decision Support System

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Abstract: This study explores the development and evaluation of a web-based enrollment appraisal system utilizing a rule-based decision support system for universities and colleges. Designed for the context of Antique, Philippines, the system leverages a two-tier architecture for efficient processing and secure data management. A user-friendly interface guides applicants through the enrollment process, while a secure server and rule-based engine analyze data against pre-defined eligibility criteria. The Rapid Application Development (RAD) methodology ensured a user-centered design with iterative development cycles incorporating user feedback. Evaluations using McCall's Software Quality Standard and the International Organization for Standardization and International Electrotechnical Commission (ISO/IEC) 25010 standard revealed the system's strengths in technical aspects (security, usability) and overall functionality. User feedback highlighted areas for improvement in interface design, clarity, and user perceptions of data security. The study concludes that the system offers a promising approach for more efficient and transparent enrollment processes. By addressing the feedback received, the system can be further enhanced to improve the user experience and build trust among applicants.

Keywords: Enrollment Appraisal, Rule Based System, Decision Support System

1. Introduction

The traditional enrollment process in educational institutions often suffers from slow turnaround times and inefficiencies. Paper applications and manual review procedures lead to delays, inconsistencies, and potential biases [1]. To address these issues, web-based enrollment appraisal systems have emerged as a powerful tool. These systems leverage technology to automate tasks, improve data management, and facilitate informed decision-making during enrollment [2].

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Web-based enrollment systems offer significant advantages for both institutions and applicants. First, they modernize application processing through automation, reducing manual workload and expediting decisions, which benefits both parties by providing quicker responses. Additionally, these systems promote transparency and consistency in the selection process. With clearly defined rules and criteria, fair evaluation is ensured, minimizing human bias. Furthermore, such systems enable data-driven decisions by collecting and analyzing applicant data, allowing institutions to make informed choices based on predefined parameters such as admission requirements and academic performance. Additionally, web-based systems improve communication by providing real-time application status updates, fostering greater transparency throughout the enrollment process, and increasing the university's efficiency in service delivery [3].

Web-based enrollment systems have evolved significantly in recent years, reflecting advancements in technology and user needs. One key trend is the integration of artificial intelligence (AI) techniques, particularly machine learning. This enables more sophisticated analysis of applicant data and allows for adaptive decision-making based on historical patterns [3].

Growing concerns about data privacy have also led to a focus on enhanced security measures within these systems. Web-based enrollment systems are now adopting stronger security protocols, such as secure data storage practices and encryption techniques [4], to safeguard applicant information.

Accessibility and user-friendliness are also key areas of development. User interfaces are being redesigned to cater to a wider range of applicants, with special attention to ensuring accessibility for individuals with disabilities [5]. This user-centric approach aims to enhance the overall experience for all applicants.

Despite their numerous advantages, web-based enrollment appraisal systems require continuous development and adaptation to specific contexts [6]. This study focuses on exploring the development of a web-based system utilizing a rule-based decision support system specifically tailored to the context of higher education in the province of Antique, Philippines. By investigating this approach, the study aims to contribute to a more efficient, transparent, and data-driven enrollment process within the chosen universities and colleges in the Philippines, incorporating the latest advancements in security, accessibility, and potentially AI integration.

Two methods were used in the study to evaluate the platform's efficacy. First, the platform's technical quality attributes, like operability, maintainability, and security, were assessed during the development and testing stages using McCall's Software Quality Standard [7]. After the platform was put into operation, a user-centered assessment was conducted to determine whether or not it had succeeded in promoting participation and improving enrollment appraisal procedures. This assessment made use of the ISO/IEC 25010 standard [8], a well-known approach for evaluating software products that establishes a model of product quality made up of eight criteria. Surveys and interviews with staff, administrators, and students also provided insightful input.

This paper's subsequent sections will examine the development process, the evaluation technique, and the main conclusions. The proponent will use McCall's model evaluation to assess the technical merits and demerits of the platform. The following system criteria — Correctness, Reliability, Efficiency, Integrity, Usability, Maintainability, Testability, Flexibility, Portability, Reusability, and Interoperability — were assessed using McCall's questionnaire [9]. In addition, the proponent will look at user input from the ISO/IEC 25010 standard assessment, analyzing the platform's strengths and weaknesses in terms of encouraging user experience and participation. The study will then go over these results and offer suggestions for improving the Enrollment Appraisal Using Rule-Based Decision Support System, which will eventually help it develop into a more precise and effective enrollment procedure.

2. Methodology

The development of this web-based enrollment appraisal system will utilize the Rapid Application Development (RAD) methodology. RAD is a user-centered approach that prioritizes early user involvement and iterative development cycles, as illustrated in Figure 1 [11]. This ensures the final product effectively meets the needs of both students and institutions. RAD's emphasis on rapid prototyping and continuous feedback allows for adjustments throughout the development process, leading to a more efficient timeline and a system that aligns with user expectations. By leveraging RAD, the development team can ensure the system is user-friendly, addresses identified challenges, and streamlines the enrollment appraisal process for all stakeholders.

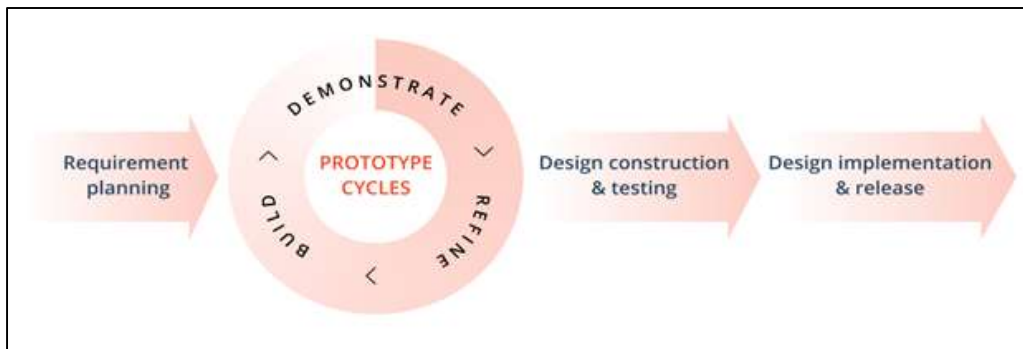


Figure 1. RAD Model of System Development Process

2.1 Requirements Analysis Phase

The initial requirement planning phase focuses on gathering user requirements through surveys, interviews, and online forums to ensure the developed enrollment appraisal system aligns with the needs of both students and institutions. This phase aims to define the system's functionalities and identify the specific data points it needs to collect from students.

2.1.1 Data Collection

The system gathers student data relevant to program eligibility through a secure and user-friendly web interface. This data encompasses essential details like name, contact information, and educational background. For academic records, the interface offers two options: secure upload of transcripts directly or, with proper authorization, integration with existing institutional databases for electronic retrieval. This streamlines the process for students and minimizes manual data entry. Standardized test scores may be required for specific programs and will be prompted within the interface. Finally, program-specific criteria like portfolios can be collected efficiently. The web interface prioritizes the user experience with clear instructions and intuitive functionalities for data entry and uploads, ensuring a smooth application process for all students considering data privacy.

2.1.2 System Architecture

Figure 2 showcases the web-based enrollment appraisal system's two-tier architecture. The first tier consists of the student interface, which allows students to complete and submit their application forms. This interface collects the necessary data and transmits it to the second tier. This design separates the user interface, where applicants interact with the system, from the core decision-making logic. The user-friendly web interface, built with technologies like Hypertext Mark-up Language (HTML), Cascading Style Sheets (CSS), and JavaScript frameworks, guides applicants through the application process, while a secure server acts as an intermediary, ensuring safe data transmission.

The second tier houses the core components of the system: the rule-based engine and the data management system. The rule-based engine, developed using a powerful programming language, processes the data received from the student's interface and applies predefined eligibility rules to assess the applicant's qualifications. The data management system is responsible for securely storing and retrieving applicant data. This architecture offers several advantages, including separation of concerns for easier maintenance, an efficient and accessible process for recording, storing, and retrieving educational data to improve data accuracy and accessibility, scalability to accommodate growth, and robust security for applicant information.

The administrator interface allows authorized personnel to access and manage the data, as well as view the results of the appraisal process. The decision or appraisal results are then communicated back to the student through the student's interface. This two-tier architecture ensures efficient processing, secure data management, and a clear separation of concerns between the user interface and the backend logic.

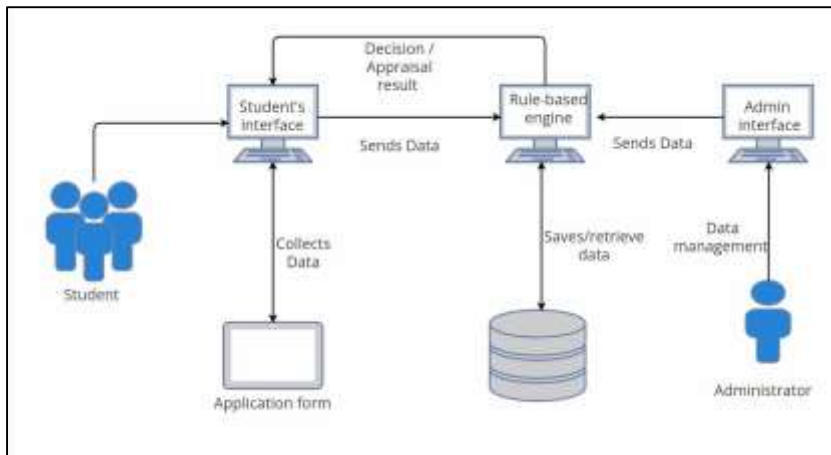


Figure 2. System Architecture

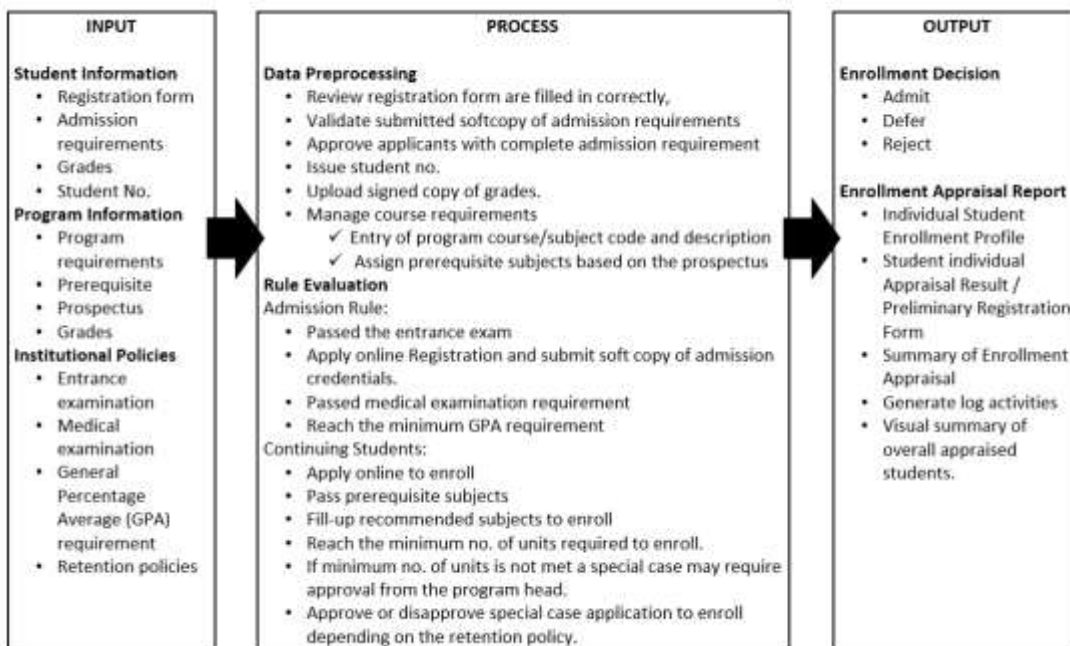


Figure 3. Input-Process-Output Model

The web-based enrollment appraisal system's architecture, when viewed through the lens of the Input-Process-Output (IPO) model, provides a clear illustration of data flow [10]. The user-friendly interface serves as the input point for applicant data, which is then securely transmitted to the rule-based engine via a secure server. This engine processes the data according to predefined eligibility rules, generating an initial appraisal result that is relayed back to the student through the web interface. Figure 3 visually represents this IPO perspective, highlighting the systematic journey of student information from collection to processing and finally to the initial appraisal decision.

2.2 Design and Development Phase

The design and development phase of the Enrollment Appraisal Using Rule-Based Decision Support System focuses on translating user requirements into a comprehensive system design and building a functional prototype. The Rapid Application Development (RAD) methodology guides this phase, emphasizing iterative development and continuous user feedback to ensure that the final product effectively meets the needs of both students and institutions.

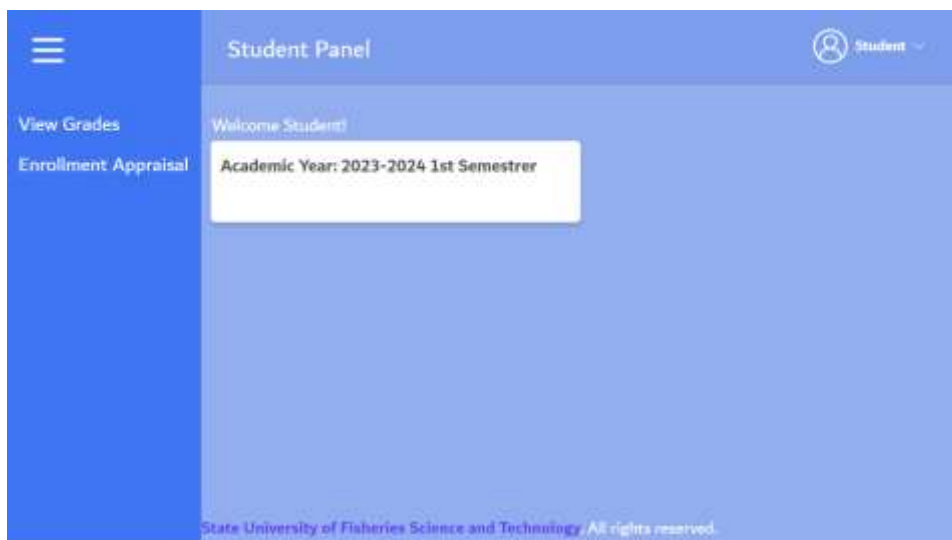


Figure 4. Student Appraisal Panel UI

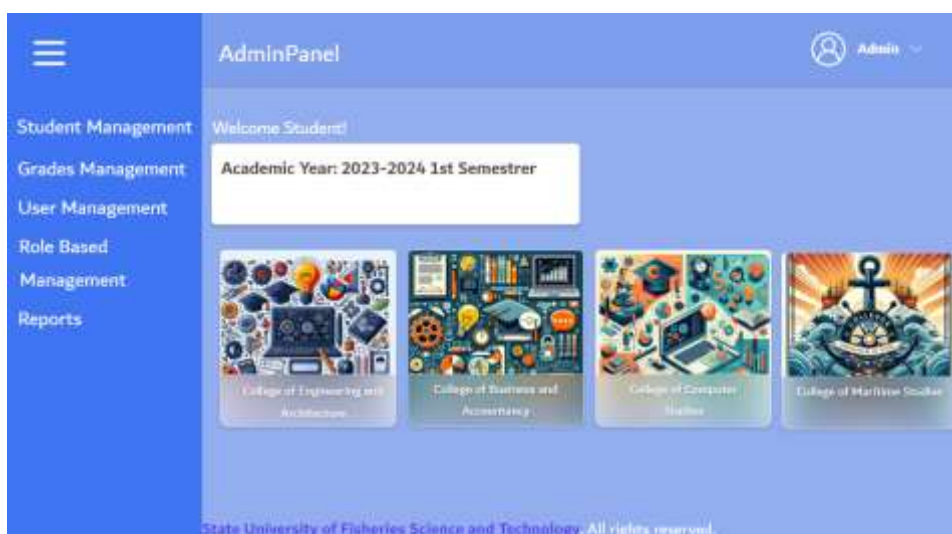


Figure 5. Admin Panel UI

The iterative nature of RAD involves developing and refining the system design in smaller cycles. During each cycle, a basic version of the system, or prototype, is created to gather user feedback on functionality, ease of use, and overall effectiveness. This feedback loop is crucial for refining the design before moving on to the next iteration, ensuring that the final system aligns closely with user expectations and requirements.

Figures 4 and 5 illustrate the User Interface (UI) designs for the Student Appraisal Panel and the Admin Panel, respectively. These interfaces are developed to be user-friendly and intuitive, catering to the specific needs of different user groups within the system.

Once the design is finalized, the focus shifts to building the actual system. The implementation phase involves developing various modules, each serving a specific function:

Dashboard Module: Displays overall data in bar chart and line graph formats, providing notifications and access to key modules based on user privileges. The admin can access user profile management, admission management, course management, rule base management, and report generation modules.

User Account Management Module: Facilitates the efficient collection of user profiles, including administrators, department in-charges, and students, and the creation of user accounts.

Student Registration Management Module: Supports the online registration of new students, including the collection of various admission documents.

Admission Management Module: Manages admission requirements for new students and confirms their enrollment once physical documents are submitted.

Course Management Module: Allows users to manage course programs, including details like program codes, subject codes, units, and prerequisites.

Rule-Base Management Module: Enables the admin to create and modify inference rules according to school admission policies and program-specific policies.

Integration with existing institutional databases will occur during this phase to ensure seamless retrieval of relevant student information. The system will be developed using technologies such as HyperText Markup Language (HTML), Cascading Style Sheets (CSS), and JavaScript for the user interface, with a secure server backend to handle data transmission and processing.

2.2.1 Frontend Development

The frontend development of the Enrollment Appraisal Using Rule-Based Decision Support System employs a combination of HTML5, CSS3, JavaScript, and Bootstrap 5 to create a user-friendly and responsive web interface.

HTML5/CSS3: HTML5 provides the structural framework for the web pages, while CSS3 handles the styling, ensuring a visually appealing and consistent design across all devices.

JavaScript: This versatile programming language is used to create interactive user interfaces and dynamic content, enhancing the overall user experience.

Bootstrap 5: As a responsive design framework, Bootstrap 5 ensures that the web application is accessible and functional across various screen sizes and devices, providing a seamless experience for all users.

2.2.2 Backend Development

The backend development is powered by CodeIgniter 4, a robust hypertext preprocessor (PHP) framework known for its simplicity and small footprint. CodeIgniter 4 is designed for developers who require a straightforward yet powerful toolkit to create full-featured web applications. This framework facilitates rapid development and efficient deployment, ensuring that the backend is scalable and capable of handling the application's demands.

2.2.3 Relevance of Technology

JavaScript, a ubiquitous programming language, plays a pivotal role in creating dynamic and interactive web experiences, making it an indispensable tool for frontend development. Its flexibility and vast community support further solidify its position as a cornerstone of modern web applications. On the backend, CodeIgniter 4, a PHP framework known for its scalability and efficiency, streamlines the development and deployment of web applications. Its lightweight nature and user-friendly interface make it an ideal choice for building the robust infrastructure required for the Enrollment Appraisal Using Rule-Based Decision Support System. The strategic combination of these technologies ensures a system that is not only robust and responsive but also user-friendly, catering to the diverse needs of all stakeholders involved in the enrollment process.

2.3 Testing and Evaluation Phase

The testing phase is done manually and employs a two-pronged approach, utilizing distinct user groups to evaluate the system's effectiveness from various perspectives. The first group comprised IT experts who meticulously assessed the technical aspects of the Enrollment Appraisal Using Rule-Based Decision Support System. The focus was on areas such as system security, performance, and scalability, ensuring its robustness and smooth operation.

The second group consisted of diverse user groups with specific roles within the enrollment process. This included administrators, admissions staff, general staff, faculty, and students. Each group's participation was crucial in evaluating the system's usability and suitability for their particular needs. Administrators and admissions staff assessed the system's efficiency in managing applications and making decisions. General staff evaluated its ease of integration with existing workflows. Faculty weighed in on its alignment with academic requirements, while students provided valuable insights into their experience navigating the enrollment process. By incorporating feedback from these diverse user groups, the testing phase aimed to achieve a comprehensive evaluation of the system's functionality and user experience.

Administrators, often registrars, tested the system's capabilities for managing user accounts, overseeing system reports and logs, and updating general admission policies. They found the system intuitive for managing accounts and policies, noting that user account management was efficient and that policy changes were applied correctly across all users. However, administrators suggested improvements in the clarity of logs and reports for better oversight, indicating a need for more detailed and user-friendly reporting tools.

Admissions staff, responsible for approving pending applications once physical copies of admission requirements are received, focused on the workflow for handling these applications. They evaluated the system's efficiency and accuracy in flagging applications for review and supporting the approval process. The feedback from the admissions staff highlighted the streamlined nature of the application processing, but they recommended enhanced notifications for pending tasks to prevent processing delays and ensure timely approvals.

General staff, assigned to specific colleges or departments, tested the system's functionality for managing prospectus content and uploading student grades. They found the grade uploading process via comma-separated values (CSV) efficient and appreciated the detailed management of course and program data. However, they suggested that more detailed error messages for CSV upload issues would facilitate troubleshooting, making the process even more user-friendly.

Faculty members, including deans and program chairs, were tasked with managing program-specific policies and rules of inference for the decision support system. They tested the system's flexibility in creating, updating, and suspending these policies and rules, ensuring accurate reflection in the decision support outcomes. Faculty feedback was positive regarding the system's flexibility, but they noted that the interface for managing complex rules could be more intuitive, highlighting an area for potential enhancement.

Students, both new and old, interacted with the system for various tasks, including registration, document uploads, enrollment appraisal, subject selection, grade viewing, and communication. New students found the registration process straightforward but suggested clearer instructions for document uploads. Old students valued the enrollment appraisal and subject recommendation features but recommended improvements in the messaging system for better communication with the administration. These insights underscored the importance of user-friendly interfaces and clear instructions to enhance the overall user experience.

The researchers invited three IT instructors with expertise in software development and quality assurance principles to evaluate the technical side of the system and utilized the established quality standards, specifically McCall's Software Quality and ISO/IEC 25010. These experts utilized established quality standards, specifically McCall's Software Quality and ISO/IEC 25010, to assess technical aspects like functionality, performance, security, and maintainability [12]. This structured evaluation ensured the system adhered to industry standards for quality software development. Both the IT expert and the group of users will rate the system using the McCall's rating scale shown in Table 1.

Table 1. McCall's Rating Scale

Rating Range	Description
4.21-5.00	Very Good
3.61-4.20	Good
2.61-3.60	Average
1.81-2.60	Fair
1.00-1.80	Poor

The evaluators' responses will be consolidated, and the average rating will be calculated based on the scale from Table 1. This average rating will serve as the basis for identifying strengths and areas needing improvement in overall user acceptance and satisfaction.

3. Results and Discussion

The testing and evaluation of the web-based enrollment appraisal system revealed valuable insights into its technical quality and user experience. The summary of the results was discussed as follows:

Technical Quality: The system was meticulously tested by the first group of evaluations using McCall's Software Quality Standard, achieving an overall mean score of 3.81, indicating "Good" quality (Table 2). This reflects strengths in traceability (well-documented code aligned with requirements), operability (user-friendly interface), communication commonality (clear and understandable interface), and hardware independence (compatibility across platforms).

Table 2. Respondents' Evaluation Results Using McCall's Standard

Criteria	Mean	Description
Audibility	4.10	Good
Accuracy	3.91	Good
Completeness	3.83	Good
Communication Commonality	4.27	Very Good
Conciseness	3.65	Good
Consistency	3.97	Good
Operability	4.31	Very Good
Security	3.75	Good
Self-Documentation	3.21	Average
Simplicity	3.06	Average
Traceability	4.42	Very Good
Training	4.09	Good
Controllability	3.90	Good
Decomposability	3.10	Average
Error Tolerance	3.86	Good
Execution Efficiency	3.77	Good
Hardware Independence	4.22	Very Good
Instrumentation	3.88	Good
Modularity	3.18	Average
Overall	3.81	Good

User Experience: A user-centered evaluation of both the first and second groups of the evaluator conducted using the ISO/IEC 25010 standard yielded an overall mean score of 4.14, signifying “High” quality (Table 3). Key strengths included functional completeness and correctness, efficient resource utilization, reliability, robust security, maintainability, and testability.

Table 3. Summary of Result of Ratings by participants using ISO/IEC 25010 Standard

Characteristics	Mean	Description
Functional Suitability Characteristics		
<i>Functional Completeness</i>	4.14	High
<i>Functional Correctness</i>	4.14	High
<i>Functional Appropriateness</i>	3.19	Moderate
Performance Efficiency Characteristics		
<i>Time Behavior</i>	3.84	Moderate
<i>Resource Utilization</i>	4.21	High
<i>Capacity</i>	4.52	High
Compatibility Characteristics		
<i>Co-existence</i>	4.32	High
<i>Interoperability</i>	4.19	High
Usability Characteristics		
<i>Appropriateness Recognizability</i>	4.30	High
<i>Learnability</i>	3.45	Moderate
<i>Operability</i>	4.60	High
<i>User Error Protection</i>	4.50	High
<i>User Interface Aesthetics</i>	3.68	High
Reliability Characteristics		
<i>Maturity</i>	4.30	High
<i>Availability</i>	4.12	High
<i>Fault Tolerance</i>	4.14	High

Security Characteristics		
<i>Confidentiality</i>	4.35	High
<i>Integrity</i>	4.06	High
<i>Accountability</i>	4.33	High
Maintainability Characteristics		
<i>Reusability</i>	4.15	High
<i>Analyzability</i>	4.02	High
<i>Modifiability</i>	4.10	High
<i>Testability</i>	4.56	High
Portability Characteristics		
<i>Adaptability</i>	4.20	High
<i>Installability</i>	4.18	High
Overall Mean	4.14	High

The evaluation revealed a system with strong technical foundations, including well-documented code, a user-friendly interface, and broad hardware compatibility. It successfully delivered all intended functionalities, efficiently managed resources, and offered robust security features, demonstrating good maintainability. However, there's room for improvement in code organization, documentation, and modularity to reduce complexity and enhance maintainability. User feedback highlighted the need for greater functional appropriateness and learnability, specifically requesting clearer instructions, a more intuitive interface, detailed task guidance, and improved communication regarding data security. These insights are valuable for future iterations, as addressing code organization will improve maintainability, while focusing on functional appropriateness and learnability will better align the system with user needs. By incorporating the suggested improvements, the user experience can be significantly enhanced, fostering greater trust and satisfaction.

4. Conclusion and Recommendations

The web-based enrollment appraisal system, built on a robust two-tier architecture and adhering to the Input-Process-Output model, successfully streamlines the student application process. The system's development, guided by the Rapid Application Development methodology, ensures a user-centric design that caters to the needs of both students and educational institutions. Evaluation using McCall's Software Quality and the ISO/IEC 25010 standard revealed high overall ratings, indicating the system's effectiveness in terms of functionality, performance, security, and maintainability.

Despite the overall strong performance of the system, certain areas have been identified for potential enhancement to further optimize the user experience and system efficiency. These include improving self-documentation to make the system more intuitive and user-friendly, simplifying complex

components to reduce errors and enhance usability, and increasing modularity for easier maintenance and future upgrades. Additionally, refining the user interface aesthetics can create a more visually appealing and engaging experience for users, while enhancing learnability can help them quickly understand and navigate the system. By addressing these areas, the system can evolve into an even more efficient, user-friendly, and effective tool for enrollment appraisal, meeting the needs of all stakeholders. Continued monitoring and user feedback will be crucial in ensuring the system's long-term success and adaptability to changing requirements.

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