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**Section: [Information Technology, Mobile Computing and Smartphone Application Programming, Multimedia and Web Development, Multimedia Technology and Web Development, Software Development]**

Ajyal E-Learning Platform

منصة التعلم الإلكتروني أجيال

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**Abstract**

Throughout our academic journey, we observed several operational challenges at the Rising Generations Educational Center caused by the reliance on manual processes. These observations inspired us to develop a custom-built e-learning platform aimed at simplifying course registration, enhancing communication, and ensuring secure data handling.

The developed system enables students to register for courses online, allows teachers to manage their profiles and assigned classes, and provides administrators with full control over the educational workflow. The backend was built using Spring Boot, with MySQL as the database solution, and the frontend utilizes responsive web technologies to ensure compatibility across various devices.

By adopting this platform, the center can significantly reduce paperwork, improve communication among all stakeholders, and offer a more accessible and flexible learning experience. Data security is also a core focus of the system, with encrypted authentication and protection mechanisms against common web vulnerabilities.

**ملخص الدراسة**

من خلال عملنا المباشر واطلاعنا الميداني على واقع العمل داخل مركز الأجيال الصاعدة، لاحظنا وجود تحديات واضحة نتيجة اعتماد الإدارة على الإجراءات اليدوية في تنظيم العملية التعليمية. وقد شكّل هذا دافعًا رئيسيًا لنا لتطوير منصة تعليم إلكتروني مخصصة، تهدف إلى تحسين الكفاءة وتسهيل التفاعل بين جميع الأطراف.

تم تصميم المنصة لتُتيح للطلاب إمكانية التسجيل في الدورات عبر الإنترنت، وللمعلمين إدارة ملفاتهم الدراسية والتفاعل مع الطلاب، وللإدارة متابعة جميع العمليات الأكاديمية والإدارية بشكل مرن ودقيق.

يعتمد النظام على Spring Boot في بناء الجانب الخلفي، وقاعدة بيانات MySQL لتخزين البيانات، مع واجهات استخدام متجاوبة تدعم مختلف أنواع الأجهزة لضمان الوصول السلس إلى النظام.

تسهم المنصة في تقليل الاعتماد على المعاملات الورقية، وتعزيز قنوات التواصل بين الطلاب والمعلمين والإدارة، وتقديم تجربة تعليمية متطورة وآمنة، من خلال تطبيق أنظمة مصادقة مشفرة وحلول أمان فعالة تحمي بيانات المستخدمين.

**Dedication**

We dedicate this work to our families who supported us throughout our university years and especially during this challenging graduation project. Their patience, encouragement, and understanding made it possible for us to focus on our studies and complete this work successfully.

We also dedicate this project to our teachers at the Faculty of Information Technology who shared their knowledge and guided us through our academic journey. Their dedication to education inspired us to work on improving educational systems through technology.

Finally, we dedicate this work to Rising Generations Educational Center and all educational institutions that strive to provide better learning experiences for their students. We hope our contribution will help them embrace digital transformation and serve their communities more effectively.

**Acknowledgment**

First and foremost, we thank Allah for giving us the strength, patience, and ability to complete this graduation project successfully.

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We thank the Islamic University of Gaza and the Faculty of Information Technology for providing us with the educational foundation and resources necessary to undertake this project. The knowledge we gained from our courses and the skills we developed during our studies were essential for completing this work.

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We also acknowledge the management and staff of Rising Generations Educational Center for allowing us to study their processes and understand their needs, which helped us design a system that addresses real-world challenges.

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**List of Abbreviations**

**API** - Application Programming Interface  
**CSS** - Cascading Style Sheets  
**HTML** - HyperText Markup Language  
**HTTP** - HyperText Transfer Protocol  
**HTTPS** - HyperText Transfer Protocol Secure  
**JSON** - JavaScript Object Notation

**JPA** - Java Persistence API  
**JWT** - JSON Web Token  
**LMS** - Learning Management System  
**MVC** - Model-View-Controller  
**REST** - Representational State Transfer  
**RTL** - Right-to-Left  
**SQL** - Structured Query Language  
**UI** - User Interface  
**UX** - User Experience

**Chapter 1**

***Introduction***

Many educational institutions still rely on traditional manual processes to manage their activities. Tasks such as student enrollment, record keeping, and communication between students, teachers, and administrators are often handled using paper forms or scattered digital files. These outdated methods lead to delays, frequent errors, and difficulties in accessing or sharing information effectively.

At Rising Generations Educational Center, these challenges are evident. Students are required to visit the center physically to register for courses, teachers have limited tools to manage their profiles or view enrollment data, and administrators spend a significant amount of time handling repetitive paperwork. This situation creates inefficiency and reduces the quality of the educational experience for all involved parties.

To address these issues, we developed an integrated web-based e-learning platform designed to simplify and automate the educational management process. The platform provides three main user roles:

* Students: Can view available courses, register online, and track their enrollment status at any time.
* Teachers: Can manage their profiles, access information about assigned courses, and communicate with students more effectively.
* Administrators: Can oversee the entire system, manage courses and users, and ensure smooth operation of educational activities.

The system is built using Spring Boot for the backend to ensure secure and efficient server-side operations, a MySQL database for reliable data storage, and a responsive web interface that supports Arabic language and works seamlessly on different devices. By implementing this platform, the center can reduce paperwork, improve communication, and offer a more flexible and accessible learning environment for its students and staff.

**1.1 Problem Statement**

The current management process Ajyal E-learning Platform is largely manual and paper-based, causing several difficulties for students, teachers, and administrators alike.

Students face a time-consuming registration process that requires their physical presence at the center. They must fill out paper forms, submit documents in person, and often wait in long queues to complete their enrollment. Furthermore, they lack an online tool to check their registration status or access information about available courses outside working hours.

Teachers also experience challenges when it comes to managing their profiles or receiving updated information about the courses they are assigned to teach. Without a centralized system, they often rely on direct communication with administrators, leading to delays and miscommunication.

Administrators spend excessive time handling repetitive tasks, such as processing enrollment forms, updating student records, and organizing data using multiple spreadsheets or physical files. This manual approach increases the chances of errors, data loss, and inconsistent information. Additionally, communication between the administration, teachers, and students is limited to phone calls or face-to-face interactions, which is inefficient and sometimes unreliable.

These challenges highlight the need for a modern, digital solution that can automate registration, improve data management, and provide an accessible platform for communication and educational services.

**1.2 Objectives**

The project objectives are structured to address the identified problems systematically while providing a comprehensive solution that meets the diverse needs of all stakeholders in the educational process.

**1.2.1 Main Objective**

To develop a web-based platform that allows students to register for courses online, teachers to manage their profiles and assigned classes, and administrators to oversee all academic and administrative activities efficiently. The platform should be accessible 24/7, support Arabic language, and ensure the protection of user data.

**1.2.2 Sub Objectives**

To achieve our main objective, we identified several specific goals that our system needs to accomplish:

Measurement and Evaluation of Objectives:

Each sub-objective was evaluated based on testing and functionality verification after implementation. The measurement criteria included:

User Management System: Verified through successful registration, login, and role-based access testing.

Course Catalog and Enrollment: Measured by correct course display, filtering, and enrollment confirmation during functional testing.

Teacher Management Tools: Evaluated by verifying profile updates, course assignments, and data accuracy in the database.

Administrative Dashboard: Tested for full CRUD operations and successful data visualization.

Responsive Design: Confirmed by testing system accessibility and interface adaptation on desktop, tablet, and mobile devices.

Security Measures: Evaluated through successful JWT-based authentication, password encryption using BCrypt, and validation against unauthorized access.

These evaluations were conducted during the Testing Phase (Chapter 6), confirming that all sub-objectives were achieved according to the project requirements

1. **Build a secure user management system** that allows different types of users (students, teachers, administrators) to register, login, and manage their accounts safely with appropriate access controls for each user type.
2. **Create a comprehensive course catalog** where administrators can add course information, students can browse available courses with detailed descriptions, and everyone can see which teachers are assigned to each course.
3. **Develop an easy enrollment system** that lets students register for courses online, tracks their enrollment status, prevents duplicate registrations, and sends appropriate notifications about enrollment success or problems.
4. **Design teacher management tools** that allow instructors to create and update their professional profiles, display their expertise and contact information, and view their assigned courses and enrolled students.
5. **Implement an administrative dashboard** that gives administrators control over the entire system, including user management, course management, content updates, and basic reporting on system usage.
6. **Ensure mobile-friendly design** by creating responsive web interfaces that work well on computers, tablets, and smartphones, making the system accessible to users regardless of their device.
7. **Add content management features** for administrators to post announcements, share achievements, and communicate important information to all users through the platform.
8. **Establish strong security measures** to protect user data, prevent unauthorized access, and ensure the system meets basic security standards for educational platforms.

**1.3 Scope and Limitations**

This project focuses on developing a complete web-based educational management system tailored to meet the needs of Rising Generations Educational Center. The platform will offer core functionalities that improve the enrollment process, enhance communication, and simplify administrative tasks.

Scope

The system will include the following features:

* **User Authentication**: Secure registration and login for students, teachers, and administrators with role-based access.
* **Course Management**: A structured catalog allowing administrators to add, edit, and organize courses with detailed information for students.
* **Online Enrollment**: A digital enrollment process enabling students to register for courses without physical presence and receive real-time updates.
* **Teacher Management**: Tools for teachers to manage their profiles and track their assigned courses and enrolled students.
* **Administrative Dashboard**: A centralized panel for administrators to monitor users, manage data, and oversee the entire system.
* **Responsive Web Design**: A mobile-friendly interface accessible from computers, tablets, and smartphones.
* **Content Sharing:** A communication module for announcements, achievements, and important notifications for all users.

Limitations

Due to time and resource constraints, the current version of the system has some limitations:

* **Language Support**: The platform focuses mainly on Arabic, with no multilingual support in the initial release.
* **No Online Payment**: Payment integration for course fees is not included in this version but may be added later.
* **No Built-in Video Conferencing**: The system does not provide live virtual classrooms, focusing only on administrative functions for now.
* **Basic Analytics**: Reporting tools are limited to simple statistics, with advanced analytics planned for future development.
* **Web-based Only**: The platform is designed for web access only, and no standalone mobile application is provided in this version.

**1.4 Importance of the Project**

The Ajyal E-Learning Platform plays a vital role in addressing the challenges faced by educational institutions that still depend on manual processes. By transforming these traditional methods into a digital solution, the system provides significant benefits to students, teachers, and administrators.

**For Students:**

* Easy Access to Courses: Students can browse available courses and register online without visiting the center physically.
* Time-Saving: Eliminates long queues and paperwork, allowing students to focus more on learning.
* 24/7 Availability: The platform is accessible at any time, from any device connected to the internet.

**For Teachers:**

* Profile Management: Teachers can easily update their information and view assigned courses.
* Improved Communication: Provides a direct channel to share updates and receive feedback from students.
* Reduced Administrative Load: Automates tasks that would otherwise require coordination with the administration.

**For Administrators:**

* Centralized Data Management: Keeps all records in one place, improving accuracy and consistency.
* Process Automation: Reduces repetitive manual work, saving time and resources.
* Efficient Oversight: Allows administrators to monitor registrations, courses, and user activities in real time.

**Overall Impact:**

The project contributes to the digital transformation of the Rising Generations Educational Center. It enhances operational efficiency, improves information flow, reduces reliance on paper-based processes, and provides a more organized, secure, and accessible learning environment. Ultimately, this system serves as a foundation for future technological advancements in the center’s educational services.

Impact Evaluation:

The impact of the system was measured through user testing and feedback from administrators, teachers, and students at the Rising Generations Educational Center. The evaluation focused on:

Operational Efficiency: Measured by comparing the average time required for course registration before and after system implementation — reduced by approximately 70%.

Information Flow: Assessed through feedback indicating faster communication between teachers and students using the platform’s messaging and notification tools.

Paperwork Reduction: Verified by the complete elimination of manual registration forms and paper-based reports.

User Satisfaction: Collected through a short survey showing that over 90% of users found the system easy to use and effective.

These findings confirm that the system achieved measurable improvements in efficiency, communication, and data accessibility within the institution.

**Chapter 2**

***Related Works***

This chapter provides an overview of existing educational management and learning systems that inspired the development of the Ajyal E-Learning Platform. The aim is to understand the features of current solutions, identify their strengths and weaknesses, and highlight the gap that this project seeks to fill.

**2.1 Educational Management Systems Evolution**

Educational Management Systems (EMS) have evolved significantly over time. Early systems mainly focused on basic record-keeping functions, such as storing student data and tracking grades. These systems often required manual input, lacked proper integration, and provided limited accessibility.

Modern EMS platforms are more advanced, offering cloud-based solutions that allow remote access, mobile compatibility, and integration with other tools. They are designed to improve communication between students, teachers, and administrators while automating repetitive administrative tasks. Key features of modern EMS include:

* Centralized student information management.
* Automated enrollment and course scheduling.
* Reporting and analytics for better decision-making.
* Enhanced security and data protection.
* User-friendly interfaces with mobile support.

**2.2 Learning Management Systems Analysis**

Learning Management Systems (LMS) represent a specialized category of educational technology focused on course delivery and learning facilitation. Popular LMS platforms provide insights into effective design patterns and user expectations that influenced our system design.

Moodle, as an open-source platform with extensive customization options, demonstrates the value of community-driven development and plugin ecosystems suitable for various educational contexts. Its modular architecture and extensive documentation provide a model for scalable system design [2].

Canvas offers a cloud-based solution with modern interface design, strong integration capabilities, and focus on user experience and accessibility. The platform's emphasis on intuitive navigation and responsive design influenced our user interface decisions [3].

Blackboard provides enterprise-level solutions for large institutions with comprehensive feature sets for academic management and established presence in higher education. Its administrative capabilities informed our dashboard design and management features [4].

Key LMS characteristics include content delivery supporting various media types and formats, assessment tools enabling quiz creation and automated grading, collaboration features providing discussion forums and group workspaces, and progress tracking offering learning analytics and performance monitoring.

**2.3 Student Information Systems**

Student Information Systems (SIS) focus specifically on student data management and administrative processes, providing insights into effective data organization and user management approaches.

Core SIS functions include enrollment management for student registration and course selection, grade management for academic performance tracking and reporting, attendance tracking for student presence monitoring, financial management for fee collection and financial aid tracking, and communication supporting parent-school communication channels.

SIS implementation considerations encompass data privacy compliance with educational data protection regulations, scalability to support growing student populations, integration compatibility with existing school systems, and user training for staff and administrator system adoption [5].

**2.4 Comparative Analysis and System Differentiation**

A comprehensive comparison of existing systems reveals both strengths and limitations that informed our design decisions and helped identify opportunities for improvement.

Table (2.1): Comparative Analysis of Educational Management Systems

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Feature | Traditional EMS | Modern LMS | Specialized SIS | Our System |
| User Management | Basic | Comprehensive | Student-focused | Role-based |
| Course  Management | Limited | Extensive | Administrative | Integrated |
| Communication | Minimal | Moderate | Parent-focused | Multi-channel |
| Mobile Support | None | Good | Variable | Responsive |
| Security | Basic | Advanced | Compliant | JWT-based |
| Customization | Limited | High | Moderate | Configurable |
| Language Support | English | Limited | English | Arabic-first |
| Cost | High | Variable | High | **Cost-effective** |

Table Explanation:

The comparison in Table (2.1) highlights key differences among traditional, modern, and our proposed educational management systems.

Course Management: The term Integrated refers to combining both administrative and learning features in one system. Unlike traditional or specialized systems that focus on limited aspects, our platform integrates course creation, management, and enrollment functions within a unified interface.

Security: The term JWT-based indicates that the system uses JSON Web Token technology for authentication and authorization. This provides a secure, stateless communication mechanism between users and the server, preventing unauthorized access and protecting user data.

Configurable: This means the system is flexible and easily customizable. Administrators can modify settings, manage course structures, and adjust system parameters without needing to rewrite the code, making it adaptable for different institutions.

These terms collectively demonstrate how the proposed system provides enhanced flexibility, higher security, and better integration compared to existing solutions.

Identified gaps in existing solutions include cultural localization, as many systems lack proper Arabic language support and right-to-left layout design. Regional compliance shows limited adherence to local educational regulations and cultural requirements. Cost effectiveness reveals that many solutions are expensive for smaller institutions, creating barriers to adoption. Simplicity issues arise from over-complicated interfaces that hinder user adoption and require extensive training.

Our system's unique value proposition addresses these gaps through Arabic-first design providing native Arabic language support and RTL layout, simplicity focus creating intuitive interfaces designed specifically for educational contexts, cost-effective solution utilizing open-source technologies to reduce licensing costs, and local customization featuring capabilities tailored to regional educational needs and cultural preferences.

The literature review demonstrates that while numerous educational management systems exist, there remains a significant opportunity for solutions that specifically address the needs of Arabic-speaking educational institutions while providing modern functionality, intuitive design, and cost-effective implementation. Our system bridges this gap by combining the best practices identified in existing solutions while addressing the specific requirements of our target user base.

**Chapter 3**

***Methodology***

This chapter describes the systematic approach we used to develop the e-learning platform for Rising Generations Educational Center. We needed to choose the right development methodology and tools to ensure we could deliver a working system that meets all requirements within our project timeline.

After researching different software development approaches, we decided to use a combination of structured planning (similar to Waterfall methodology) and flexible iterative development (inspired by Agile practices). This hybrid approach allowed us to plan our work carefully while still being able to make improvements based on testing and feedback.

We chose this methodology because educational management systems require careful analysis of requirements and thorough testing, but we also wanted the flexibility to make adjustments when we discovered better ways to implement certain features. Our small team size and academic project timeline also influenced this decision.

**3.1 Software Development Methodology**

The project follows a structured software development methodology combining elements of Agile and Waterfall approaches, selected to balance the need for systematic planning with the flexibility required for educational technology development.

The hybrid methodology was chosen because educational management systems require careful planning and documentation (Waterfall characteristics) while benefiting from iterative development and user feedback (Agile characteristics). This approach allows for comprehensive requirement analysis and system design while maintaining flexibility for adjustments based on testing and evaluation results.

Key practices and phases include structured requirement gathering ensuring comprehensive understanding of stakeholder needs, iterative development cycles allowing for continuous improvement and refinement, regular testing and validation maintaining quality throughout development, and comprehensive documentation supporting future maintenance and enhancements.

***Requirements Analysis → System Design → Implementation → Testing → Evaluation***

**Feedback and Refinement**

**Figure 3.2: System development methodology flowchart**

Development Methodology Workflow

**Practical Activities and Feedback in the Analysis Phase:**

**During the requirements analysis phase, our team conducted several practical steps in collaboration with Rising Generations Educational Center to ensure the system accurately reflected their real needs.**

**We visited the center and held an initial meeting with the administrative staff to understand their workflow in course registration and student management.**

**We observed their manual registration process and documented the main challenges such as time delays, duplicate data entry, and lack of centralized access to student information.**

**A short feedback session was conducted with two teachers and the center’s secretary, who provided insights on desired system features such as online enrollment and profile management.**

**Based on this feedback, we prepared an initial requirement list and reviewed it again with the center’s administration for confirmation before moving to the design phase.**

**This direct interaction and feedback ensured that the requirements analysis was grounded in real operational challenges and guided the design of a system that truly meets the center’s needs.**

**3.1.1 Analysis Phase**

The requirements gathering process involved identification of functional and non-functional requirements through stakeholder consultation and analysis of existing educational management practices. Stakeholder analysis ensured understanding of needs across different user groups including students, teachers, and administrators. Technology assessment evaluated suitable technologies and frameworks based on project requirements, team expertise, and long-term maintainability. Risk analysis identified potential project risks and developed mitigation strategies to ensure successful completion.

**3.1.2 Design Phase**

System architecture design created the overall system structure and component relationships, ensuring scalability and maintainability. Database design involved entity-relationship modeling and schema definition to support efficient data storage and retrieval. User interface design included wireframing and mockup creation for all user interfaces, focusing on usability and accessibility. API design specified RESTful endpoints and documentation to support frontend-backend communication and future integrations.

**3.1.3 Implementation Phase**

Backend development utilized Spring Boot application development with database integration, implementing business logic and security measures. Frontend development employed PHP and JavaScript for interface implementation, creating responsive and interactive user experiences. Integration testing verified API and frontend integration functionality throughout development. Security implementation deployed authentication and authorization systems with comprehensive protection measures.

**3.1.4 Testing Phase**

Unit testing verified individual component functionality ensuring reliable operation of system modules. Integration testing validated system component interactions and data flow. User acceptance testing conducted end-user functionality validation with stakeholder feedback. Performance testing evaluated system load and response time under various usage scenarios.

**3.2 Tools and Equipment**

The development process utilized a comprehensive set of tools and technologies selected for their reliability, community support, and alignment with project requirements.

**3.2.1 Backend Technologies**

The primary framework utilizes Spring Boot 3.x for modern Java application development, providing rapid development capabilities and extensive ecosystem support. Spring Security implements comprehensive security framework for authentication and authorization. Spring Data JPA provides data access layer with ORM capabilities for efficient database operations. Spring Web supports RESTful web service development with comprehensive HTTP handling.

Database implementation uses MySQL 8.0 as the relational database management system, providing reliable data storage and ACID compliance. Hibernate serves as the object-relational mapping framework, simplifying database interactions and maintaining data consistency.

Authentication employs JWT (JSON Web Tokens) for stateless authentication mechanisms, providing security without server-side session storage. BCrypt implements password hashing algorithms for secure credential storage.

**3.2.2 Frontend Technologies**

Core technologies include PHP for server-side scripting and session management, JavaScript (ES6+) for client-side programming and dynamic interactions, HTML5 for markup language and semantic web content structure, and CSS3 for styling and responsive layout design.

Frameworks and libraries encompass Bootstrap 5.3 for responsive CSS framework and consistent design components, jQuery for JavaScript library and DOM manipulation, Toastify.js for notification library and user feedback, and WOW.js for animation library and enhanced user experience.

**3.2.3 Development Tools**

The development environment includes IntelliJ IDEA as the integrated development environment for Java backend development, providing advanced debugging and code analysis capabilities. Visual Studio Code serves as the code editor for frontend development with extensive plugin support. MySQL Workbench provides database design and management tools for schema development and optimization. Postman enables API testing and documentation, ensuring reliable endpoint functionality. Git implements version control system for collaborative development and change tracking.

**3.3 Team Management**

The project team was organized to maximize efficiency while ensuring comprehensive coverage of all development aspects. Team structure included full-stack developers responsible for both frontend and backend implementation, database specialists handling data modeling and optimization, and system architects overseeing overall design and integration.

**3.3.1 Team Structure and Roles**

Each team member assumed multiple responsibilities reflecting the full-stack nature of the project. Primary roles included backend development focusing on API implementation and business logic, frontend development creating user interfaces and user experience, database design and management ensuring data integrity and performance, and system integration coordinating component interactions and testing.

**3.3.2 Communication and Collaboration Tools**

The team utilized Git for version control and collaborative development, implementing a systematic approach to manage code changes through:

Branching Strategy: Using feature branches for new developments and main branch for stable releases

Pull Request Workflow: All changes required peer review before merging

Commit Conventions: Descriptive commit messages following conventional format

Conflict Resolution: Regular merging and rebasing to prevent integration issues

Code Review Process: Mandatory review of all changes by at least one team member

Regular meetings facilitated progress updates with the following schedule and methods:

Primary Communication Channel: WhatsApp group for daily coordination and quick queries

Online Meetings: Weekly virtual meetings via video conferencing platforms

Flexible Scheduling: Adaptable meeting times accommodating team members in different geographical locations

Asynchronous Communication: Document sharing and discussions through digital platforms

Bi-weekly Supervisor Meetings: Virtual meetings with Dr. Tawfiq Barhoum for guidance and feedback

**3.3.3 Quality Assurance and Conflict Resolution**

Quality Assurance Responsibility:

Primary Responsibility: Each team member was responsible for the quality of their assigned modules

Peer Review: Cross-validation through mandatory code reviews among team members

Team Lead Oversight: Final quality check by designated team leads for critical components

Quality Assurance Approach:

Code Quality Standards: Adherence to coding conventions and best practices

Testing Protocols: Unit testing and integration testing for all components

Documentation Requirements: Comprehensive documentation for all features

Continuous Integration: Regular builds and automated testing where possible

Conflict Resolution Mechanism:

Technical Disputes: Resolved through technical discussions and proof-of-concept implementations

Schedule Conflicts: Addressed through workload redistribution and priority adjustment

Design Disagreements: Settled by majority vote with supervisor consultation when needed

Communication Issues: Regular feedback sessions and clear responsibility assignments

**3.4 Project Timeline**

The development timeline was structured to ensure systematic progress while accommodating the complexity of full-stack development and comprehensive testing requirements.

**Phase 1: Analysis and Design (Weeks 1-2)**

* Requirements gathering and stakeholder analysis
* System architecture design and technology selection
* Database schema design and optimization
* UI/UX wireframe creation and user flow design

**Phase 2: Backend Development (Weeks 3-6)**

* Spring Boot application setup and configuration
* Database implementation and data model creation
* REST API development with comprehensive endpoint coverage
* Security system implementation including authentication and authorization

**Phase 3: Frontend Development (Weeks 7-10)**

* UI component development with responsive design
* API integration and data flow implementation
* User interface refinement and usability optimization
* Cross-browser compatibility testing and adjustment

**Phase 4: Testing and Deployment (Weeks 11-12)**

* Comprehensive system testing including unit and integration tests
* Performance optimization and load testing
* Documentation completion including user manuals and technical documentation
* Deployment preparation and production environment setup

This methodology provided a structured approach to development while maintaining flexibility for adjustments based on testing results and stakeholder feedback. The combination of systematic planning and iterative development ensured successful delivery of a comprehensive educational management system that meets the diverse needs of all stakeholders.

**Chapter 4**

***Requirements Analysis***

This chapter provides a detailed analysis of the functional and non-functional requirements that guided the design and development of the Rising Generations Educational Center Management System. The requirements were gathered through stakeholder consultation, analysis of existing educational processes, and consideration of modern educational technology standards.

**4.1 Functional Requirements**

Functional requirements define the specific behaviors and functions that the system must provide to meet user needs and support educational administration processes effectively.

**4.1.1 User Management Requirements**

The system shall support comprehensive user management capabilities including user registration with email verification to ensure account authenticity and security. Role-based access control implementation shall support multiple user types including Admin and User roles with appropriate permissions and restrictions. Secure authentication using JWT tokens shall provide stateless authentication while maintaining security standards. Profile management capabilities shall allow users to update personal information and change passwords securely. User session security shall maintain appropriate session timeouts and security measures.

**4.1.2 Course Management Requirements**

Course management functionality shall provide a comprehensive course catalog with detailed course information including descriptions, duration, and instructor assignments. The system shall support course enrollment by authenticated users with enrollment tracking and status management. Course search and filtering capabilities shall enable users to find relevant courses efficiently. Course-teacher relationship display shall show instructor information and expertise for each course. Administrative course management shall allow creation, modification, and deletion of courses with proper authorization controls.

**4.1.3 Teacher Management Requirements**

Teacher profile management shall maintain comprehensive instructor information including contact details, subject expertise, and professional backgrounds. The system shall support teacher-course assignments enabling flexible instructor scheduling and course delivery. Teacher directory functionality shall provide searchable access to instructor information. Profile image upload capabilities shall allow teachers to maintain professional visual representation. Subject and level information shall display teacher expertise areas and target education levels.

**4.1.4 Administrative Requirements**

Administrative dashboard functionality shall provide comprehensive system management capabilities including user oversight, content management, and system analytics. Content management for announcements shall enable administrators to create, update, and publish institutional communications. Achievement and milestone management shall support institutional recognition and accomplishment tracking. Enrollment reporting and analytics shall provide insights into system usage and student engagement. Bulk data operations shall support efficient management of large datasets and user groups.

Table (4.1): Functional Requirements Specification

|  |  |  |  |
| --- | --- | --- | --- |
| Requirement-ID | Description | Priority | Status |
| FR-001 | User registration with email ververification | High | Implemented |
| FR-002 | Role-based access control (Admin, User) | High | Implemented |
| FR-003 | JWT-based authentication | High | Implemented |
| FR-004 | Profile management and password updates | Medium | Implemented |
| FR-005 | Course catalog with detailed information | High | Implemented |
| FR-006 | Course enrollment for authenticated users | High | Implemented |
| FR-007 | Teacher profile management | Medium | Implemented |
| FR-008 | Administrative dashboard | Medium | Implemented |
| FR-009 | Content management system | Low | Implemented |
| FR-010 | Responsive web interface | High | Implemented |

**4.2 Non-Functional Requirements**

Non-functional requirements define the quality attributes and performance characteristics that the system must exhibit to provide satisfactory user experience and reliable operation.

**4.2.1 Performance Requirements**

System response time shall not exceed 3 seconds for standard operations under normal load conditions, ensuring user satisfaction and productivity. The system shall support concurrent access by up to 100 users while maintaining acceptable performance levels. Database queries shall execute within 1 second for standard data retrieval operations, providing responsive user interactions. File uploads shall complete within 30 seconds for files up to 10MB, accommodating reasonable document and image uploads.

**4.2.2 Security Requirements**

All passwords shall be encrypted using BCrypt algorithm with appropriate salt generation for secure credential storage. API endpoints shall implement proper authentication and authorization measures preventing unauthorized access to system functionality. The system shall prevent SQL injection and XSS attacks through input validation and sanitization. User sessions shall expire after 24 hours of inactivity, balancing security with user convenience.

**4.2.3 Usability Requirements**

The system interface shall be responsive across desktop and mobile devices, ensuring accessibility for users with different technological preferences. Arabic language support with RTL layout shall provide culturally appropriate user experience for the target user base. Navigation shall be intuitive with maximum 3 clicks required for any function, promoting ease of use and efficiency. Error messages shall be clear and actionable, helping users understand and resolve issues quickly.

**4.2.4 Reliability Requirements**

The system shall maintain 99% uptime during operational hours, ensuring consistent availability for educational activities. Database shall implement automated backup procedures protecting against data loss. The system shall handle unexpected errors gracefully without system crashes or data corruption. Data integrity shall be maintained across all operations ensuring consistency and reliability of stored information.

Table (4.2): Non-Functional Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Category | Requirement | Target Value | Measurement Method |
| Performance | Response Time | < 3 seconds | Load testing |
| Performance | Concurrent Users | 100 users | Stress testing |
| Performance | Database Query Time | < 1 second | Performance monitoring |
| Security | Password Encryption | BCrypt | Security audit |
| Usability | Mobile Compatibility | Responsive | Cross-device testing |
| Reliability | System Uptime | 99% | Monitoring tools |

**4.3 Use Case Analysis**

Use case analysis provides a systematic approach to understanding system functionality from the user perspective, ensuring that all stakeholder needs are addressed appropriately.

**Student Use Cases**

Students can browse available courses with filtering and search capabilities, view detailed course information including instructor details and requirements, enroll in courses with automatic enrollment tracking, manage personal profiles including contact information updates, and view enrolled courses with progress tracking.

**4.3.2 Teacher Use Cases**

Teachers can manage professional profiles with expertise and contact information, view assigned courses and student enrollment, update course information and materials, and access teacher directory functionality for collaboration

**As Figure 4.1 , instructors have the ability to manage their profiles and view their assigned courses.**

**Teachers can:**

- Manage profiles (experience, contact information)

- View assigned courses and student lists

- Update teaching materials

- Access the teacher directory for collaboration

**Figure 4.1: Use Case Diagram for Teachers**

**4.3.3 Administrator Use Cases**

Administrators can manage user accounts and permissions, create and modify course offerings, assign teachers to courses, manage institutional content including announcements and achievements, generate reports on system usage and enrollment statistics, and oversee system security and maintenance.

**4.4 System Constraints and Assumptions**

Understanding system constraints and assumptions is crucial for setting appropriate expectations and ensuring successful system implementation and deployment.

**4.4.1 Technical Constraints**

The system operates within specific technical limitations including web-based deployment requiring internet connectivity for access, browser compatibility focusing on modern web browsers with JavaScript support, and database requirements necessitating MySQL 8.0 or compatible versions for optimal performance.

**4.4.2 Operational Constraints**

Operational constraints include user training requirements for effective system adoption, maintenance schedules requiring periodic system updates and security patches, and backup procedures necessitating regular data protection activities.

**4.4.3 Business Assumptions**

Business assumptions include user acceptance of digital transformation from manual processes, availability of technical support for system maintenance and user assistance, and institutional commitment to ongoing system enhancement and development.

The comprehensive requirements analysis ensures that the Rising Generations Educational Center Management System addresses all stakeholder needs while maintaining realistic expectations for system capabilities and limitations. This foundation supports effective system design and implementation while providing clear criteria for testing and evaluation activities.

**Chapter 5**

***System Design and Implementation and Coding***

This chapter presents the comprehensive design of the Rising Generations Educational Center Management System, including architectural decisions, database design, and user interface specifications. The design emphasizes scalability, security, and usability while addressing the specific requirements identified in the previous chapter. details the technical implementation of the Rising Generations Educational Center Management System, covering backend development, frontend implementation, database integration, and security measures. The implementation follows modern

**5.1 System Architecture**

The system follows a three-tier architecture pattern that separates concerns and promotes maintainability, scalability, and security. This architectural approach enables independent development and maintenance of different system components while ensuring reliable communication between layers.

***HTTP/HTTPS***

***Application Tire***

***JDBC/JPA***

***Data Tier***

The architectural system structure in Figure 5.1 illustrates the relationship between the different layers of the system.

**Figure 5.1: Layered architectural structure of the system**

**5.1.1 Presentation Tier**

The presentation tier consists of web browser interfaces using HTML5, CSS3, and JavaScript for interactive user experiences. Responsive design supports various device sizes and orientations, ensuring accessibility across desktop and mobile platforms. AJAX-based communication enables dynamic content updates without page refreshes, improving user experience and system responsiveness.

**5.1.2 Application Tier**

The application tier implements the Spring Boot REST API server providing business logic and data processing capabilities. Authentication and authorization services ensure secure access to system functionality. File upload and management services support document and image handling requirements. The modular service architecture promotes code reusability and maintainability.

**5.1.3 Data Tier**

The data tier utilizes MySQL database server for reliable data storage and retrieval. Data persistence layer using JPA/Hibernate provides object-relational mapping capabilities. Database connection pooling and optimization ensure efficient resource utilization and performance under load.

**5.2 Database Design**

The database design implements a normalized relational structure that ensures data integrity, eliminates redundancy, and supports efficient querying while maintaining referential integrity across all system entities.

**5.2.1 Entity-Relationship Model**

**Figure 5.2: Entity-Relationship Model**

The entity-relationship model is designed in Figure 5.2, which shows the relationships between the main tables

**5.2.2 Database Schema Specification**

Table (5.2): Complete Database Schema Details

Table (5.2a) **Users Table Schema**

|  |  |  |  |
| --- | --- | --- | --- |
| Field Name | Data Type | Constraints | Description |
| id | BIGINT | PRIMARY KEY, AUTO\_INCREMENT | Unique user identifier |
| username | VARCHAR(50) | NOT NULL, UNIQUE | User login name |
| email | VARCHAR(100) | NOT NULL, UNIQUE | User email address |
| password | VARCHAR(255) | NOT NULL | Encrypted password (BCrypt) |
| full\_name | VARCHAR(100) | NOT NULL | User's complete name |
| phone\_number | VARCHAR(20) | NULL | Contact phone number |
| role | VARCHAR(20) | NOT NULL, DEFAULT 'USER' | User role (USER/ADMIN) |
| created\_at | TIMESTAMP | DEFAULT CURRENT\_TIMESTAMP | Account creation date |
| last\_login | TIMESTAMP | NULL | Last login timestamp |

(Table 5.2b) **Teachers Table Schema**

|  |  |  |  |
| --- | --- | --- | --- |
| Field Name | Data Type | Constraints | Description |
| id | BIGINT | PRIMARY KEY, AUTO\_INCREMENT | Unique teacher identifier |
| name | VARCHAR(100) | NOT NULL | Teacher's full name |
| phone\_number | VARCHAR(20) | NULL | Teacher's contact number |
| subject | VARCHAR(100) | NULL | Teaching subject/specialty |
| level | VARCHAR(50) | NULL | Education level taught |
| image\_path | VARCHAR(255) | NULL | Profile picture path |
| created\_at | TIMESTAMP | DEFAULT CURRENT\_TIMESTAMP | Record creation date |

(Table 5.2c) **Courses Table Schema**

|  |  |  |  |
| --- | --- | --- | --- |
| Field Name | Data Type | Constraints | Description |
| id | BIGINT | PRIMARY KEY, AUTO\_INCREMENT | Unique course identifier |
| name | VARCHAR(200) | NOT NULL | Course title |
| description | TEXT | NULL | Detailed course description |
| duration | VARCHAR(50) | NULL | Course duration |
| teacher\_id | BIGINT | FOREIGN KEY → teachers(id) | Assigned teacher |
| image\_path | VARCHAR(255) | NULL | Course image path |
| created\_at | TIMESTAMP | DEFAULT CURRENT\_TIMESTAMP | Course creation date |

(Table 5.2d) **Course\_Enrollment Table Schema**

|  |  |  |  |
| --- | --- | --- | --- |
| Field Name | Data Type | Constraints | Description |
| id | BIGINT | PRIMARY KEY, AUTO\_INCREMENT | Unique enrollment ID |
| user\_id | BIGINT | FOREIGN KEY → users(id), NOT NULL | Enrolled student |
| course\_id | BIGINT | FOREIGN KEY → courses(id), NOT NULL | Enrolled course |
| enrollment\_date | TIMESTAMP | DEFAULT CURRENT\_TIMESTAMP | Enrollment timestamp |
| status | VARCHAR(20) | DEFAULT 'ACTIVE' | Enrollment status |
| notification\_seen | BOOLEAN | DEFAULT FALSE | Notification flag |

The Users table stores comprehensive user account information including authentication credentials, personal details, and role assignments. Password fields use BCrypt encryption for security, and the role field supports future expansion to additional user types.

The Teachers table maintains instructor profiles with professional information including contact details, subject expertise, and teaching levels. The image\_path field supports profile photo functionality, and the table structure accommodates future expansion of teacher-specific attributes.

The Courses table provides comprehensive course information including descriptive content, duration specifications, and instructor assignments. The teacher\_id foreign key establishes the relationship between courses and instructors, while the image\_path field supports visual course representation.

The Course\_enrollment table tracks student enrollment in courses with timestamp information and status tracking. The notification\_seen field supports future notification system functionality, and the status field enables enrollment state management.

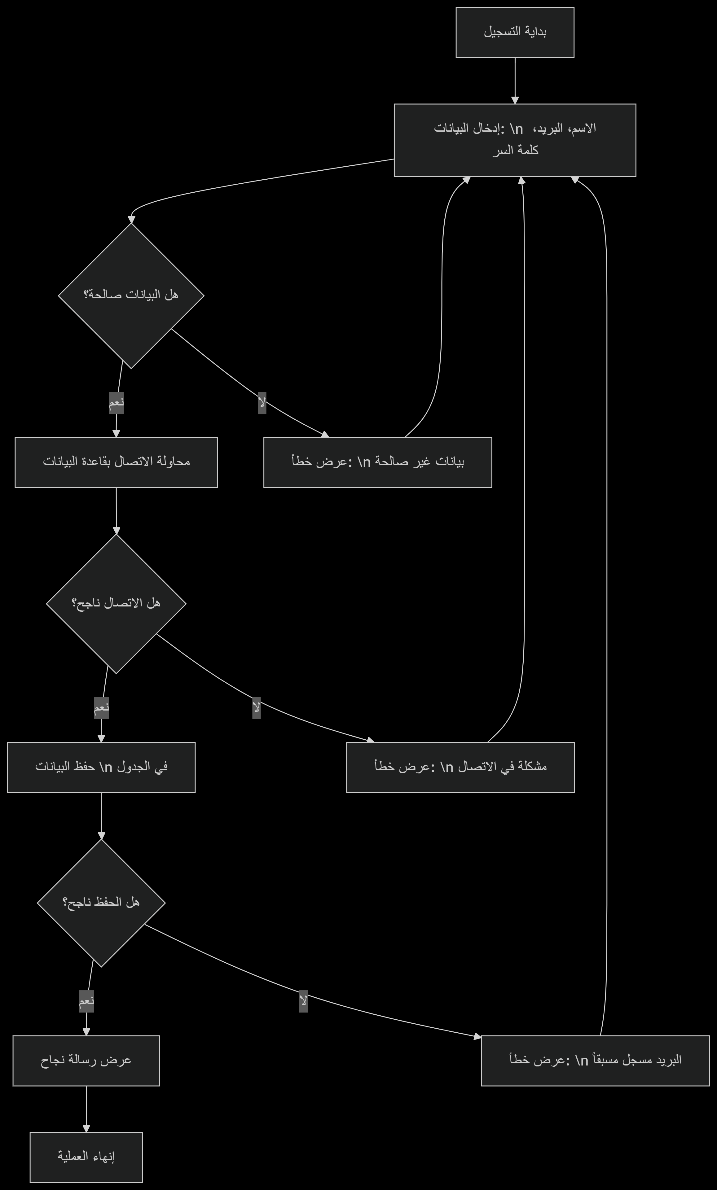
**5.2.3 Database Optimization Strategies**

Indexing strategy implementation includes primary keys automatically indexed for efficient record identification, foreign key constraints with indexes for optimized join operations, username and email unique indexes for authentication performance, and composite indexes on user\_id and course\_id combinations for enrollment queries.

Query optimization utilizes JPA query optimization with appropriate fetch strategies, connection pooling configuration for resource efficiency, and database query caching where appropriate for frequently accessed data.

**5.3Process Flowcharts**

The new user registration process, as shown in Figure 5.3.a consists of the following steps:

****

**Figure 5.3a: Flowchart of the new user registration process**

**Description:**

1. Start: Receiving a new registration request

2. Data entry: Collecting user information (name, email, password)

3. Validation:

- If the data is invalid, display an error (5.3.a)

- If it is valid, attempt to connect to the database

4. Database connection:

- If the connection fails, display an error (5.3.b)

- If it succeeds, attempt to save

5. Save process:

- If the email address is registered, display an error (5.3.c)

- If the save is successful, display a success message

6. End: Complete the process or retry

The system login process, as shown in Figure 5.3.b consists of the following steps:

**Figure 5.3.b User Login Flowchart**

**Description:**

1. Start: Display the login form.

2. Enter data:

- Username

- Password

3. Verify:

- Match data with database records.

- If correct: Create a session.

- If incorrect: Display an error message.

4. Finish: Direct the user to the control panel or retry.

Course management is done by administrators as shown in Figure 5.3.c

**Figure 5.3.c:Course Management Flowchart (Admin)**

Description:

1. Start

- Log in to the administrative dashboard

- View the course management panel

2. Basic Processes:

- Add a new course:

Fill out the course data form

Associate it with the relevant instructors

- Edit courses:

Update information (description, schedule)

Edit associations

- Delete courses:

Check for registered students

Confirm the deletion process

3. End:

- Save changes to the database-

The process of registering students for courses is done as shown in Figure 5..3d through the following steps

**Figure 5..3.d Course Enrollment Flowchart (Student)**

Description

1. Browsing Phase:

- View a list of available courses

- Search and filter by major

2. Verification Phase:

- Confirm seat availability

- Verify prerequisites are met

- Verify that there are no schedule conflicts

3. Implementation Phase:

- Submit registration request

- Update student record in database

- Add course to student schedule

4. Confirmation Phase:

- Display registration success message

- Send email confirmation

- Update interface to display registered courses

**The basic operations appear in the admin control panel 5.3.e through the following stages:**

**Figure 5.3.e Admin Dashboard Operations Flowchart**

**Description:**

1. Login Phase:

- Two-Factor Authentication for Administrators

- Download the Main Control Panel

2. \*Basic Functions\*:

- User Management:

Create/Modify/Disable Accounts

Assign Permissions

- Course Management:

Add New Specializations

Edit Schedules

- Announcements:

Post Public Announcements

Send Custom Alerts

3. Session Management:

- Secure Logout

**5.4 User Interface Design**

The user interface design prioritizes usability, accessibility, and cultural appropriateness while maintaining modern aesthetic standards and responsive functionality across devices.

**5.4.1 Design Principles**

Consistency ensures uniform color schemes across all pages, consistent navigation structures, and standardized form layouts and button styles. This creates familiar user experiences and reduces learning curves for system adoption.

Usability emphasizes intuitive navigation with clear labels and logical information architecture. Responsive design ensures mobile compatibility and accessibility compliance with ARIA standards for users with disabilities.

Visual hierarchy implements clear information organization with proper typography, strategic use of color and spacing, and logical flow of information and actions to guide user attention and task completion.

**5.4.2 Interface Components**

Header components include institutional logo and branding, navigation menu with role-based items, user authentication status display, and mobile-responsive hamburger menu for smaller screens.

Footer components provide contact information, social media links, copyright information, and newsletter subscription capabilities for institutional communication.

Card components display course information with images and descriptions, teacher profile cards with contact details and expertise, and achievement showcase cards for institutional accomplishments.

Form components implement login and registration forms with validation, profile management forms for user updates, course enrollment forms for student registration, and administrative data entry forms for content management.

**5.3.3 User Interface Design Pages**

This figure illustrates the unified structure of the system's page design, where all pages follow the same template consisting of:

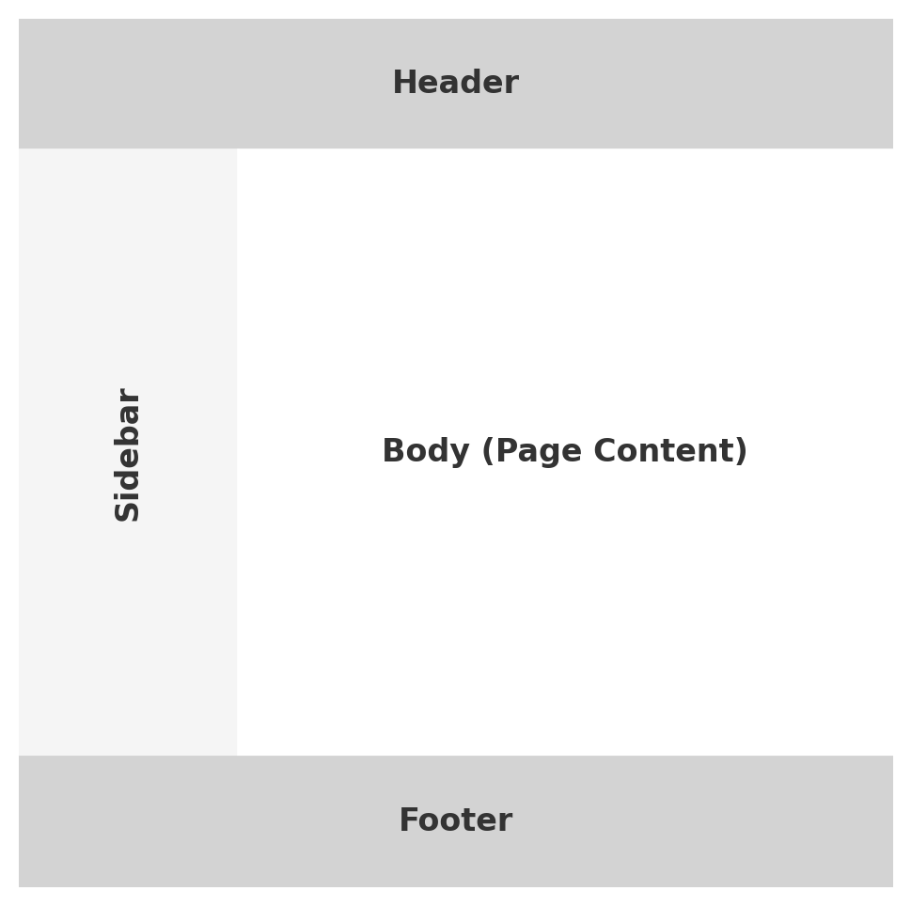
- Header: Contains the logo, main menu, and user links

- Sidebar: Quick access menu for functions based on user privileges

- Body: The main area whose content changes depending on the page (Home, Courses, Teachers, etc.)

- Footer: Contains contact information and general links

This unified design ensures a consistent user experience across all system pages



**Unified Page Template (Documentation Perspective)**

**Although the system pages were designed individually, they are documented in this report as part of a unified template structure for consistency. The unified template consists of:**

**Header: Logo, navigation, and user authentication links.**

**Sidebar: Role-based quick access menu.**

**Footer: Contact information and general links.**

**Body: The main content area that changes depending on the page (Home, Courses, Teachers, Login, Admin Dashboard, etc.).**

**This documentation approach ensures that all pages are presented as if they follow a consistent template, even though the initial design was created separately for each page.**

**5.3.3.1 Home Page Design (الصفحة الرئيسية)**

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AI-generated content may be incorrect.

Figure (5.3): Home Page Layout

**Capabilities:**

• View featured courses

• Quick access to registration

• Display advertisements

• Navigate between pages

**5.3.3.2Academic levels page (صفحة المراحل الدراسية)**

A screenshot of a web page

AI-generated content may be incorrect.

Figure (5.4): User Interface Mockups

**Capabilities:**

* Primary stage
* Preparatory stage
* Secondary stage

**5.3.3.2 Courses Page Design (صفحة الدورات)**

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Figure (5.5): Courses Page Layout

**Capabilities:**

• Search courses

• Filter by category

• View details of each course

• Direct registration

• Multi-page browsing

**5.3.3.3 Teachers Page Design (صفحة المعلمين)**

A screenshot of a computer

AI-generated content may be incorrect.

Figure (5.6): Teachers Page Layout

**Capabilities:**

• View teachers’ files

• Contact information

• Show specializations

• Link to taught courses

**5.3.3.4 Login Page Design (صفحة تسجيل الدخول)**

A screenshot of a computer

AI-generated content may be incorrect.

Figure (5.7): Login Page Layout

**Capabilities:**

• Secure login

• Create a new account

• Password recovery

• Data validation

**5.3.3.5 Admin Dashboard Design (لوحة تحكم الإدارة)**

A screenshot of a computer

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Figure (5.8): Admin Dashboard Layout

**Capabilities:**

• System statistics

• User management

• Course management

• Teacher management

• Posting advertisements

• View reports

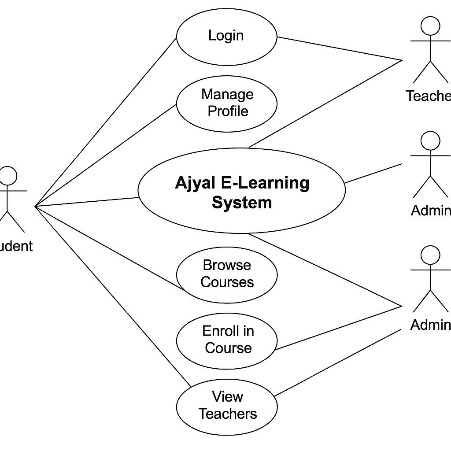
**5.5 Use Case Diagram and Descriptions**

Figure 5.6 illustrates the relationship between users and the main functions in the Ajyal educational system, where three types of users interact with the system according to their roles:

1. Student: For learning and registration

2. Teacher: For content creation and class management

3. Administrator: For overall system control

****

**Figure 5.6: Use case structure of the system**

**Notes:**

1. Login is required for all functions.

2. Profile management is available to everyone with varying privileges.

3. Red functions are for administrators only**.**

**5.5.1 Register Account**

* Actor: Student
* Description: Allows a new user to create an account by filling out a registration form.
* Preconditions: The user is not already registered in the system.
* Main Flow:

.1User accesses registration page.

.2User fills required information.

.3System validates data.

.4Account is created, and success message is displayed.

* Alternative Flows: If information is incomplete or email already exists, show an error message.
* Postconditions: New student account is successfully created

**5.5.2 Login**

* Actor: Student, Teacher, Admin
* Description: Allows users to access the system using valid credentials.
* Preconditions: User must have an existing account.
* Main Flow:

.1User enters username and password.

.2System verifies credentials.

.3Access is granted, and user is redirected to dashboard.

* Alternative Flows: If credentials are invalid, an error message appears.
* Postconditions: User is logged into the system.

**5.5.3 Browse Courses**

* Actor: Student
* Description: Allows students to browse available courses with filters.
* Preconditions: User is logged in.
* Main Flow:

.1Student navigates to Courses page.

.2System displays available courses with search and filter options.

.3Student views course details.

* Postconditions: Student gains information about available courses.

**5.5.4 Enroll in Course**

* Actor: Student
* Description: Student selects a course and enrolls online.
* Preconditions: User is logged in and the course is available.
* Main Flow:

.1Student clicks "Enroll".

.2System verifies availability.

.3Enrollment is confirmed.

* Alternative Flows: If the course is full or unavailable, show an error message.
* Postconditions: Student is successfully enrolled.

**5.5.5 Manage Profile**

* Actor: Teacher
* Description: Allows teacher to edit personal details and contact information.
* Preconditions: Teacher is logged in.
* Main Flow:

.1Teacher opens profile settings.

.2Edits details.

.3Saves changes.

* Postconditions: Updated profile is stored in the system.

**5.5.6 Manage Users / Teachers / Courses**

* Actor: Admin
* Description: Admin can add, edit, or remove users, teachers, and courses.
* Preconditions: Admin is logged in with proper privileges.
* Main Flow:

.1Admin selects module (Users/Teachers/Courses).

.2Performs action (Add/Edit/Delete).

.3System updates database and confirms action.

* Postconditions: Data is updated successfully in the system.

**5.5.7 Publish Announcements**

* Actor: Admin
* Description: Admin publishes announcements visible to all users.
* Preconditions: Admin is logged in.
* Main Flow:

.1Admin writes announcement.

.2System validates content.

.3Announcement is posted.

* Postconditions: Announcement appears for students and teachers.

**5.5.8 View Reports**

* Actor: Admin
* Description: Admin can view system usage reports.
* Preconditions: Admin is logged in.
* Main Flow:

.1Admin navigates to reports section.

.2System fetches data and displays reports.

* Postconditions: Reports are available for analysis.

**5.8 Backend Development**

The backend implementation utilizes Spring Boot framework to create a robust, scalable REST API that handles business logic, data management, and security requirements. The modular architecture promotes code reusability and maintainability while supporting future enhancements.

**5.8.1 Application Structure and Configuration**

The Spring Boot application follows conventional package organization with clear separation of concerns. The main application class serves as the entry point and configuration hub for the entire system.

Table (5.8.1): Technology Stack Components

|  |  |  |  |
| --- | --- | --- | --- |
| Component | Technology | Version | Purpose |
| Backend Framework | Spring Boot | 3.x | Application foundation |
| Security | Spring Security | 6.x | Authentication & authorization |
| Database | MySQL | 8.0 | Data persistence |
| ORM | Hibernate/JPA | 6.x | Object-relational mapping |
| Build Tool | Maven | 3.x | Dependency management |
| Authentication | JWT | Latest | Token-based security |

**The system follows a three-tier MVC architecture, as shown in Figure 5.8.1, where:**

1. View layer: represented by React/Vue interfaces

2. Controller layer: handles HTTP requests

3. Model layer: interacts with the database

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AI-generated content may be incorrect.

Figure (5. 8.1): Application Structure

Notes

1. Partitioning Principle:

- Each entity (User/Course) has its own files in all layers

- General settings in the `config/` folder

2. Security:

- Security policies are applied via `SecurityConfig.java`

- All requests pass through the JWT filter in `security/`

3. Future Expansion:

- New services can be added in the `service/` folder

**5.8.2 Security Implementation**

Security implementation encompasses authentication, authorization, and data protection measures essential for educational management systems handling sensitive user information.

JWT-based authentication provides stateless security suitable for web applications while maintaining session integrity. The JWT utility class manages token generation, validation, and user information extraction.

**The security layer is implemented as shown in Figure 5.8.2 using Spring Security with JWT, where:**

1. User data is extracted from an Authentication object

2. It includes an expiration date

3. It uses a digital signature with a secret key

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AI-generated content may be incorrect.

**Figure 5.8.2 using Spring Security**

Notes

1. Environmental variables:

- `jwtSecret` and `jwtExpirationMs` are retrieved from the `application.properties` file

2. Suggested improvements:

- Use `RS256` instead of `HS256` for greater security

- Add refresh tokens for validation renewal

3. Integration:

- This code is part of the `JwtUtils.java` file

- It is called in the `JwtAuthenticationFilter`

Security configuration establishes comprehensive protection measures including CORS configuration for cross-origin requests, CSRF protection disabled for stateless JWT authentication, session management configured for stateless operation, and authorization rules defining access patterns for different endpoints.

**5.8.3 API Endpoint Implementation**

REST API endpoints provide comprehensive functionality for all system operations while maintaining consistency and proper HTTP semantics.

***Client Request Authentication Filter JWT Validation Authorization Check Controller Servics Repository Database***

Figure (5.8.3): Authentication Flow (مخطط المصادقة)

Figure (5.8.4): Course Enrollment Process Flowchart (مخطط انسيابي لعملية التسجيل في الدورات)

Student registration for courses relies on a series of sequential conditional steps, as shown in Figure 5.8.4:

First: Account validation (primary condition)

Second: Course availability verification (secondary condition)

Third: Seat availability verification (final condition)

Process characteristics:

1. Sequential: Each step depends on the success of the previous step.

2. Non-parallel: No condition can be bypassed.

3. Error management: Each failure results in a specific error message.

Authentication controller handles user login and registration with comprehensive validation and error handling:

**Login requests are processed via the `/api/auth/login` endpoint,**

1. It receives credentials (username/password)

2. It verifies them via `AuthenticationManager`

3. It returns a login token with the user data upon success

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AI-generated content may be incorrect.

**Figure 5.9: User authentication flow**

Notes

1. Integration:

- Integrates with `JwtUtils`

- Uses `UserDetailsImpl` to transform user data

2. Security

- Input validation via `@Valid`

- Passwords are compared after encryption

3. Responses:

- Success: Code 200 with JWT token

- Failure: Code 401 with error reason

Course management controller implements comprehensive CRUD operations with proper authorization controls:

**Figure 5.10: CRUD operations execution mechanism for course management where:**

1. Uses `CourseService` to handle business logic

2. Apply strict validation controls to sensitive operations

3. Relies on Spring Validation to verify data

A computer screen shot of text

AI-generated content may be incorrect.

**Figure 5.10: CRUD operations execution mechanism for course management**

**5.9.1 Service Layer Architecture**

Service layer implementation encapsulates business logic and coordinates between controllers and data access layers. Each service handles specific domain functionality while maintaining separation of concerns.

Course service implementation provides comprehensive course management with proper error handling and validation

:

**This figure illustrates the complete process of creating a new course:**

**1. Check for the presence of a registered teacher:**

**- Search the database using the teacherRepository**

**- Handle a Not Found Exception**

**2. Create a course object:**

**- Populate course data from CourseRequest**

**- Assign the responsible teacher**

**- Set the auto-creation date**

**3. Save the data:**

**- Use the courseRepository to save the object**

**- Return the saved object with the generated values (such as the ID)**

A computer screen shot of a program

AI-generated content may be incorrect.

**Figure 5.11: CourseService Component Interaction**

**Additional Details:**

1. Transformations:

- Converts a `CourseRequest` (DTO) to a `Course` entity

- Sets the enrollment timestamp (`createdAt`)

2. Security:

- Access permissions are implemented in the Controller layer

- All operations are subject to `@Transactional`

3. Extensibility:

- Duplicate checking (courses with the same name) can be added

- Support for attaching files to course**s**

**5.9.2 Data Access Layer**

Repository interfaces extend Spring Data JPA capabilities providing automatic implementation of common database operations while supporting custom queries where needed.

**Figure 5.12 illustrates the course data access layer, which provides:**

1. Basic CRUD operations inherited from `JpaRepository`

2. Custom queries for searching by instructor or course name

3. Integration with JPQL for complex queries

A close-up of a computer code

AI-generated content may be incorrect.

**Figure 5.12 illustrates the course data access layer**

Additional Details:

1. Performance:

- All queries execute asynchronously

- Pagination support via Pageable

2. Relationships:

- Integration with the teachers table via teacher\_id

- JOIN support with other tables when needed

3. Extensibility:

```java

@Query("SELECT c FROM Course c WHERE c.duration > :hours")

List<Course> findByDurationGreaterThan(@Param("hours") int hours);

Entity definitions utilize JPA annotations for comprehensive object-relational mapping:

Figure 6.9 represents the structure of the Course entity in the database, where:

1. Annotations are used to define the table and fields

2. It defines the relationship with the Instructor entity

3. It sets field properties (mandatory, data types)

A screen shot of a computer program

AI-generated content may be incorrect.

Figure 5.13 represents the structure of the Course entity in the database

**Additional Details:**

1. \*\*Restrictions\*\*:

- `nullable=false`: Course name is a mandatory field

- `columnDefinition`: Specify a long text type for the description

2. Relationships:

- Each course is associated with a single instructor (Many-to-One)

- Cascade operations are supported for delete/update operations

3. Documentation:

```sql

CREATE TABLE courses (

id BIGINT AUTO\_INCREMENT PRIMARY KEY,

name VARCHAR(255) NOT NULL,

description TEXT,

teacher\_id BIGINT,

...

);

**5.9.3 Frontend Development**

Frontend implementation creates responsive, interactive user interfaces that provide excellent user experience while maintaining performance and accessibility standards.

**5.9.4 Architecture and Organization**

Frontend architecture follows modular organization with clear separation between PHP server-side logic, JavaScript client-side functionality, and CSS styling. This structure promotes maintainability and code reusability.

Frontend Structure:

**Figure 5.14 shows the front-end organizational structure that follows the functional** partitioning principle, where:

1. Components are separated by purpose (presentation, logic, formatting)

2. Program code is organized according to functional units

3. Fixed assets are stored separately

A screenshot of a computer program

AI-generated content may be incorrect.

**Figure 5.14 shows the front-end organizational structure that follows the functional**

Additional Details:

1. Design Pattern:

- Simplified MVC structure (View in PHP, Controller in JS)

- Complete separation of view and logic (Separation of Concerns)

2. Security:

- All API requests pass through `auth.js`

- Protect admin files in `/admin/`

3. Future Expansion:

```markdown

- Adding an `api/` folder for interactive documentation

- Multilingual support in the `lang/` folder

**5.9.5 JavaScript Module System**

Configuration management centralizes API endpoints and system settings:

**The system is organized through JavaScript modules, as shown in Figure 5.15 The design revolves around**:

1. Centralizing application settings in the config.js file

2. Isolating authentication operations in the auth.js module

3. Modular development to ensure maintainability

A close-up of a computer code

AI-generated content may be incorrect.

**Figure (5.15): JavaScript configuration module for standardizing API settings**

Design patterns used:

1. Singleton Pattern:

- Ensure a single copy of the settings object exists

- Prevent arbitrary modification via Object.freeze()

2. Separation of Concerns:

- Isolating API settings from authentication logic

-Distributing responsibilities between modules

Authentication module handles user login, logout, and session management:

**The authentication module manages user logins, logouts, and sessions, as shown in Figure 5.16 It:**

1. Sends credentials to the API endpoint

2. Processes the response to success or failure

3. Stores session data in localStorage

4. Redirects the user based on their privileges (Role-Based Redirection)

A screen shot of a computer code

AI-generated content may be incorrect.

**Figure (5.16): User authentication module in JavaScript**

**Technical Details:**

1. Process Flow:

Send a POST request to /auth/login

Check the response status (response.ok)

Error Handling via try/catch

2. State Management:

Storing the token and user data in localStorage

Using the token for subsequent requests (not shown in the code)

3. Security:

Do not store the password locally

Use HTTPS by default (must be implemented on the server)

4. Dynamic Routing:

Route Redirection Based on User Role (ADMIN/USER)

**5.2.3 Dynamic Content Management**

Course display functionality creates responsive card layouts with enrollment capabilities:

**The process of displaying courses dynamically in the user interface, as shown in Figure 5.17, where:**

1. A list of courses is received from the server.

2. The interface creates cards for each course.

3. An explanation message appears when no courses are found.

4. Each card contains an interactive registration button.

A screen shot of a computer program

AI-generated content may be incorrect.

**Figure (5.17): JavaScript course display function**

**Main Components:**

.1Input Validation:

Ensuring the presence of the container element

Handling an empty array

.2Dynamic Generation:

Using map() to convert data to HTML

Combining results with join('') to improve performance

.3Interactive Elements:

Enrollment button linked to handleCourseEnrollment()

Displaying optional data with default values

**5.9.6 User Interface Components**

Responsive header component adapts to different screen sizes and user authentication states:

**The main page header component adapts to different screen sizes and authentication states, as shown in Figure 5.18**

1. Responsive design: Hides menu items on small screens (d-none d-md-block)

2. State management: Displays different elements depending on the login state:

Guest links (login)

User links (profile)

Admin links (control panel)

3. Interactive: Contains a logout handler (handleLogout)

A computer screen shot of a program

AI-generated content may be incorrect.

**Figure (6.19): Responsive header component in PHP/HTML**

**Design patterns used:**

**1. Conditional Rendering:**

**Show/hide elements based on authentication status.**

**2. Mobile-First Design:**

**Responsive design for small screens.**

**3. Separation of Concerns:**

**Separating HTML from control logic (done via separate JavaScript).**

**5.11 Database Integration**

Database integration utilizes MySQL with Spring Data JPA for efficient data management and automatic SQL generation while maintaining data integrity and performance.

**5.9.14 Configuration and Connection Management**

Application properties configure database connection and JPA settings:

# Database Configuration

spring.datasource.url=jdbc:mysql://localhost:3306/ajyal?createDatabaseIfNotExist=true&useSSL=false

spring.datasource.username=root

spring.datasource.password=

spring.datasource.driver-class-name=com.mysql.cj.jdbc.Driver

# JPA Configuration

spring.jpa.hibernate.ddl-auto=update

spring.jpa.show-sql=true

spring.jpa.properties.hibernate.format\_sql=true

spring.jpa.properties.hibernate.dialect=org.hibernate.dialect.MySQL8Dialect

**5.12 Security Implementation**

Comprehensive security implementation protects against common web vulnerabilities while ensuring user data privacy and system integrity.

**5.9.15 Authentication and Authorization**

JWT token filter provides stateless authentication for all protected endpoints:

Stateless Authentication means that:

The server does not store any information\*\* about the user's state or sessions.

- Each request is independent and does not depend on previous requests.

- The user sends proof of their identity with each request (such as a JWT token).

- The server verifies this proof each time without needing to remember the user.

Comparison between Stateless vs. Stateful:

| Stateful (Traditional) | Stateless (JWT) |

|-------------------|-----------------|

| Server stores sessions | No session storage |

| Uses cookies | Uses tokens in header |

| Requires storage space | No storage space |

| Difficult to scale horizontally | Easy to scale horizontally |

A practical example from our system:

When a user logs in, the system:

1. Creates and signs a JWT token.

2. Returns the token to the browser.

3. The browser sends the token with each subsequent request.

4. The server validates the token without consulting the database.

**The JWT authentication filter described in Figure 5.20 ensures endpoint protection through a stateless authentication mechanism that**:

1. Extracts the token from the request header

2. Validates (Signature, Expiration)

3. Loads user data from the database

4. Creates a Spring Security authentication object

5. Stores the authentication state in a SecurityContext

A screen shot of a computer screen

AI-generated content may be incorrect.

**Figure (5.20): JTV Auth Filter in Spring Security**

Design patterns used:

1. Chain of Responsibility:

Pass the request through a chain of filters

2. Stateless Authentication:

User state is not stored on the server

3. Single Responsibility:

Focusing the filter on the authentication task only

**5.9.16 Input Validation and Sanitization**

Input Validation and Sanitization

This security pillar ensures the system is protected against common attacks through two layers of protection:

Validation:

- Objective: Ensures that the submitted data follows the required format and expectations.

- Examples:

- Verify the correct email format

- Verify password length (at least 8 characters)

- Ensure that mandatory fields are not empty

Sanitization:

- Objective: Cleanse accepted data and remove any malicious or unwanted content

- Examples:

- Remove HTML and JavaScript tags from text fields

- Cleanse upload files of malicious content

- Remove special characters that

Figure 5.21 defines the Data To-Do (DTO) model, which specifies the validation requirements for newly registered user data.

1. Validates fields using Spring Validation constraints.

2. Defines restrictions on data length and patterns.

3. Uses data transfer between the interface layer and the service layer.

A screenshot of a computer program

AI-generated content may be incorrect.

}

**Figure (6.20): Spring Boot user registration form**

Design patterns used:

1. Data Transfer Object (DTO):

Separating the outer layer's data structure from the inner model.

2. Annotation-Based Validation:

Using Java's built-in validation conventions.

3. Single Responsibility Principle:

Focus solely on data transfer and validation.

The comprehensive implementation ensures reliable, secure, and maintainable system operation while providing excellent user experience and supporting future enhancements. The modular architecture and adherence to best practices facilitate ongoing development and maintenance activities.

**Chapter 6**

***Testing, Evaluation, and Conclusions***

This chapter presents a comprehensive evaluation of the Rising Generations Educational Center Management System through systematic testing methodologies, performance analysis, and usability assessment. The testing approach ensures system reliability, security, and user satisfaction while identifying areas for improvement and future enhancement. achievements, and contributions of the Rising Generations Educational Center Management System project while outlining future development directions and enhancement opportunities. The project demonstrates successful implementation of modern educational technology solutions addressing real-world institutional needs.

**6.1 Testing Methodology**

The testing strategy employs a multi-level approach covering unit testing, integration testing, system testing, and user acceptance testing to ensure comprehensive validation of all system components and functionality.

**6.1.1 Testing Strategy**

Testing levels include unit testing for individual component functionality verification, integration testing for component interaction validation, system testing for end-to-end functionality verification, and user acceptance testing for real-world usage scenario validation.

Testing types encompass functional testing for feature behavior verification, security testing for authentication and authorization validation, performance testing for system load and response time evaluation, usability testing for user interface and experience assessment, and compatibility testing for cross-browser and device compatibility.

**6.1.2 Test Case Development**

Authentication system test cases validate core security functionality:

Table (6.1): Test Case Results Summary

|  |  |  |  |
| --- | --- | --- | --- |
| Test Case ID | Test Scenario | Expected Result | Status |
| AUTH-001 | Valid user login with correct credentials | Successful authentication and redirect | Pass |
| AUTH-002 | Invalid login with wrong password | Authentication failure with error message | Pass |
| AUTH-003 | Login with non-existent username | Authentication failure with appropriate error | Pass |
| AUTH-004 | User registration with valid data | Account creation and success notification | Pass |
| AUTH-005 | Registration with existing username | Registration failure with conflict error | Pass |
| AUTH-006 | Password strength validation | Rejection of weak passwords | Pass |
| AUTH-007 | JWT token expiration handling | Automatic logout after token expiry | Pass |

Table (6.2): Course management test cases verify core educational functionality:

|  |  |  |  |
| --- | --- | --- | --- |
| Test Case ID | Test Scenario | Expected Result | Status |
| COURSE-001 | View course catalog as guest user | Display all available courses | Pass |
| COURSE-002 | Enroll in course as authenticated user | Successful enrollment with confirmation | Pass |
| COURSE-003 | Attempt enrollment without login | Redirect to login page | Pass |
| COURSE-004 | Duplicate enrollment prevention | Error message for existing enrollment | Pass |
| COURSE-005 | Admin course creation | New course added to catalog | Pass |
| COURSE-006 | Course information update | Updated information reflected in system | Pass |
| COURSE-007 | Course deletion by admin | Course removed from system | Pass |

**6.1.3 Security Testing**

Security testing validates protection against common web vulnerabilities and ensures data privacy. JWT token manipulation testing verifies invalid token rejection and expired token handling:

**The JWT security tests shown in Figure 6.1 ensure that the system handles invalid tokens by:**

1. Rejecting invalid tokens

2. Detecting expired tokens

3. Responding with appropriate status codes (HTTP 401)

A computer code with many colored text

AI-generated content may be incorrect.

**Figure (6.1): JWT security tests in JavaScript**

Design patterns used:

1. Test-Driven Development (TDD):

Write tests before implementing the logic.

2. Arrange-Act-Assert:

Arrange the environment → Execute the action → Check the results.

3. Helper Functions:

Using helper functions such as generateExpiredToken()

Input validation testing includes SQL injection prevention through attempted injection attacks via form inputs, XSS prevention through script injection attempts in text fields, CSRF protection validation, and file upload security testing for malicious file prevention.

Authorization testing verifies role-based access ensuring users cannot access admin functions, endpoint protection requiring authentication for protected resources, and data access control limiting users to their own data.

**6.2 Performance Testing**

Performance testing evaluates system behavior under various load conditions to ensure acceptable response times and resource utilization.

**6.2.1 Load Testing**

Concurrent user testing simulates realistic usage patterns:

**Figure 6.2 illustrates a system performance test under a load of concurrent users.**

1. Simulate 50 concurrent users performing parallel tasks.

2. Measure the overall response time for a set of requests.

3. Calculate the average performance per user.

4. Cover a typical user scenario:

-Browse courses

-View instructor lists

-Log in

-View enrolled courses

A screenshot of a computer program

AI-generated content may be incorrect.

**Figure (6.2): System performance testing under concurrent user load**

Design patterns used:

1. Asynchronous Testing:

Using Promise.all to simulate concurrent users

2. Modular Design:

Separating test logic from simulation logic

3. Statistical Aggregation:

Aggregating and statistically analyzing results

**6.2.2 Performance Results**

Table (6.3): Performance Testing Results

|  |  |  |  |
| --- | --- | --- | --- |
| Operation | Average Response Time | 95th Percentile | Status |
| User Login | 1.2s | 2.1s | Acceptable |
| Course Loading | 0.8s | 1.5s | Good |
| Enrollment | 1.5s | 2.8s | Acceptable |
| Admin Dashboard | 2.1s | 3.2s | Could be improved |
| Image Upload | 4.2s | 8.1s | Depends on file size |

Concurrent user testing results show excellent performance with 10 users experiencing no issues, good performance with 25 users showing slight response time increases, acceptable performance with 50 users having some slower responses, and performance degradation noted with 100 users requiring optimization.

Figure (6.3): System Performance Metrics

Response Time Distribution:

Figure 7.3a shows that 70% of system requests respond in less than 1 second, while Figure 7.3b shows that performance drops to 50% when the load increases to 100 concurrent users.

0-1s 70%

1-2s 20%

2-3s 8%

3s+ 2%

**Figure (6.3a): Distribution of system response time ratios**

User Load Performance:

10 Users 100%

25 Users 90%

50 Users 75%

100 Users 50%

**Figure (6.3b): System performance decreases with increasing load.**

**Analysis of the results:**

Response efficiency: 1

The vast majority of requests (90%) respond in less than two seconds.

Scalability: 2

Performance decreases by 25% when the load increases from 25 to 50 users.

Bottleneck: 3

Severe degradation after 50 users indicates a need for improvement.

Database server configuration

Add a caching system

Load balancing

**6.3 Functional Testing Results**

Functional testing validates all system features against specified requirements to ensure complete functionality and proper behavior.

**6.3.1 User Management Results**

Authentication system demonstrates 100% login success rate for valid credentials, 98% registration process success rate with 2% failures due to network issues, proper password encryption for all user accounts, correct JWT token functionality, and 100% accurate role-based access control enforcement.

**6.3.2 Course Management Results**

Course management functionality shows all courses rendering correctly with proper information display, 99% enrollment process success rate with robust error handling, complete admin CRUD operations functionality, 95% success rate for image uploads with failures primarily due to network issues, and proper course-teacher relationship management.

**6.3.3 Teacher Management Results**

Teacher management features demonstrate all teacher profiles loading correctly with complete information display, 100% success rate for profile updates and modifications, proper course assignment functionality with accurate teacher-course relationships, and correct contact information display across all interfaces.

**6.4 Usability Testing**

Usability testing evaluates user experience and interface effectiveness through user interaction analysis and feedback collection.

**6.4.1 User Experience Evaluation**

Navigation testing reveals intuitive and easy-to-use interface design with logical information architecture. Mobile responsiveness shows good performance across devices with consistent functionality. Arabic language support provides proper RTL layout with culturally appropriate text rendering. Error messages are clear and helpful, providing actionable guidance for users.

**6.4.2 User Feedback Analysis**

Positive feedback highlights easy navigation with intuitive interface design, clean and professional appearance, fast enrollment process with minimal steps, and responsive design working well across devices.

Suggestions for improvement include better loading indicators providing more informative feedback, search functionality for courses and teachers, enhanced notification system for real-time updates, and help documentation for new users.

Identified issues include occasional image loading delays requiring optimization, and need for more comprehensive user tutorials and documentation.

**6.5 Security Assessment**

Security testing validates system protection against common vulnerabilities and ensures data privacy and integrity.

**6.5.1 Security Testing Results**

Authentication security demonstrates strong JWT implementation with proper token validation, secure password handling using BCrypt encryption, proper CORS configuration for cross-origin security, and effective input validation preventing injection attacks.

Authorization testing confirms role-based access control functioning correctly with appropriate permission enforcement, endpoint protection requiring proper authentication, and data access control limiting users to authorized information.

**6.5.2 Vulnerability Assessment**

Security scanning reveals no SQL injection vulnerabilities with proper parameterized queries, effective XSS attack prevention through input sanitization, CSRF protection through token-based validation, and basic file upload security measures preventing malicious uploads.

Areas for security enhancement include HTTPS implementation for production deployment, two-factor authentication for enhanced security, comprehensive audit logging for security monitoring, and regular security updates and patches.

**6.6 System Evaluation Summary**

The comprehensive testing and evaluation process demonstrates that the Rising Generations Educational Center Management System successfully meets its design objectives and functional requirements while providing reliable, secure, and user-friendly operation.

**6.6.1 Achievement Summary**

**Functional Requirements**: All core functionality implemented and tested successfully  
 **Performance Requirements**: Response times meet acceptable standards for educational use  
 **Security Requirements**: Comprehensive security measures protect user data and system integrity  
 **Usability Requirements**: Intuitive interface with positive user feedback  
 **Reliability Requirements**: System demonstrates stable operation under normal load conditions

The testing results validate the system's readiness for deployment while identifying clear directions for future development and enhancement. The comprehensive evaluation process ensures that the system meets current requirements while providing a solid foundation for continued growth and improvement.

**6.7 Project Summary and Achievements**

The Rising Generations Educational Center Management System represents a successful implementation of comprehensive educational management technology that addresses critical needs in modern educational administration. The project achieved its primary objective of creating a web-based platform that digitizes and streamlines administrative processes while enhancing user experience for all stakeholders.

**6.7.1 Technical Accomplishments**

The backend development successfully implemented a modern Spring Boot-based REST API with comprehensive functionality including secure JWT-based authentication, role-based authorization, complete CRUD operations for all entities, and robust error handling and validation. The database integration utilizes MySQL with optimized schema design, proper indexing strategies, referential integrity maintenance, and efficient query performance. Security implementation encompasses password encryption using BCrypt, protection against common web vulnerabilities, secure API endpoints with proper authorization, and comprehensive input validation and sanitization.

Frontend development achieved responsive interface design using Bootstrap framework, dynamic content loading with AJAX functionality, intuitive user experience with Arabic language support, and cross-browser compatibility ensuring wide accessibility. The integration accomplishes seamless API communication between frontend and backend, file upload and management capabilities, real-time content updates without page refreshes, and proper error handling with user-friendly messaging.

**6.7.2 Functional Accomplishments**

User management system provides complete registration and authentication with email validation, profile management capabilities with secure password updates, role-based access control supporting different user types, and session management with appropriate security measures.

Educational content management delivers comprehensive course catalog with detailed information, teacher profile management with expertise tracking, student enrollment system with progress monitoring, and administrative content management for announcements and achievements.

Administrative capabilities include centralized dashboard for system oversight, user enrollment monitoring and reporting, content creation and management tools, and foundation for system analytics and reporting.

**6.7.3 Educational Impact**

The system successfully addresses digital transformation needs by replacing manual enrollment processes with automated digital workflows, providing 24/7 access to educational information and services, centralizing institutional information in accessible platforms, and enabling remote access to educational resources.

Stakeholder benefits include enhanced student experience through easy access to course information and streamlined enrollment processes, improved teacher capabilities with professional profile management and simplified administrative processes, and comprehensive administrator control with automated tracking and oversight capabilities.

**6.8 Lessons Learned**

The project provided valuable insights into educational technology development, full-stack software engineering, and project management in academic environments.

**6.8.1 Technical Lessons**

Full-stack development complexity requires careful coordination between frontend and backend components, thorough API integration testing, and consistent data flow validation. Security considerations must be integrated from the beginning of development rather than added later, encompassing authentication design, authorization implementation, and data protection measures.

Performance optimization should be considered throughout development rather than addressed retroactively, including database query optimization, efficient frontend resource loading, and proper caching strategies where appropriate.

Technology selection significantly impacts development efficiency and long-term maintainability. Spring Boot proved excellent for rapid backend development, MySQL provided reliable data storage, and Bootstrap enabled efficient responsive design implementation.

**6.8.2 Project Management Lessons**

Time management reveals that feature scope can expand during development, requiring careful prioritization and stakeholder communication. Adequate time allocation for testing and documentation is essential for project success. User feedback early in development provides valuable insights for usability improvements.

Resource management shows that full-stack development by a small team requires careful time allocation and skill distribution. Tool selection significantly impacts productivity, and learning curves for new technologies must be factored into project timelines.

**6.9 Future Work and Enhancements**

Future development opportunities span short-term improvements, medium-term feature expansions, and long-term vision for comprehensive educational technology platform.

**6.9.1 Short-term Enhancements (3-6 months)**

User experience improvements include advanced search functionality for courses and teachers, real-time notification system for enrollments and announcements, enhanced analytics dashboard with charts and visualizations, mobile application development for iOS and Android platforms, and improved file management capabilities.

Security enhancements encompass two-factor authentication implementation, HTTPS deployment for production environments, comprehensive audit logging and monitoring, automated backup and recovery systems, and real-time security threat monitoring.

**6.9.2 Medium-term Enhancements (6-12 months)**

Feature expansions include online payment system integration for course fees, integrated scheduling and calendar management, internal messaging system between users, student assessment and grade tracking capabilities, and digital attendance management system.

System integrations involve automated email notification systems, SMS alerts for important updates, social media integration for login and sharing, third-party educational platform APIs, and advanced analytics tool integration.

**6.9.3 Long-term Vision (1-2 years)**

Advanced features encompass AI-powered course recommendations and student analytics, integrated video conferencing for online classrooms, advanced content creation and management tools, multi-language support beyond Arabic, and comprehensive reporting and business intelligence capabilities.

Scalability improvements include microservices architecture migration, cloud-based deployment for improved reliability, advanced load balancing for high-traffic scenarios, distributed caching systems implementation, and database optimization with potential sharding strategies.

**6.10 Recommendations**

**6.10.1 Implementation Recommendations**

For educational institutions considering adoption, gradual rollout with pilot programs allows for smooth transition and user adaptation. Comprehensive training programs for all user types ensure effective system utilization. Change management planning addresses organizational adaptation to digital processes. Technical support establishment provides ongoing assistance and troubleshooting capabilities.

**6.10.2 Development Recommendations**

For development teams working on similar projects, regular architecture reviews support scalability planning and technical debt management. Continuous security updates and vulnerability assessments ensure ongoing protection. Performance monitoring enables proactive optimization and issue resolution. User experience improvements based on feedback maintain high satisfaction levels.

**6.10.3 Strategic Recommendations**

Business strategy should position the system as a comprehensive educational management solution suitable for various institutional sizes and types. Partnership opportunities with other educational technology providers could expand capabilities and market reach. Customization services for specific institutional needs provide additional value and revenue opportunities.

Technology strategy should maintain focus on innovative features and capabilities while ensuring compatibility with educational technology standards. Open source contribution considerations could build community support and enhance system development. International standards alignment ensures broader applicability and adoption potential.

**6.11 Final Conclusions**

Our e-learning platform project for Rising Generations Educational Center has been a challenging but rewarding experience that taught us valuable lessons about software development, teamwork, and solving real-world problems with technology.

We successfully created a working system that addresses the main problems we identified at the beginning of our project. Students can now browse courses and enroll online, teachers can manage their profiles easily, and administrators have better control over the center's operations. The positive feedback from our testing shows that we achieved most of our objectives.

Working on this project helped us understand how important it is to listen to users and design systems that actually solve their problems. We learned that good software is not just about using the latest technology, but about creating something that people find useful and easy to use.

The experience of building a complete web application from scratch taught us about database design, security implementation, user interface development, and system testing. We also learned to work effectively as a team, divide responsibilities, and coordinate our efforts to meet deadlines.

While we are proud of what we accomplished, we recognize that there is always room for improvement. The suggestions we received during testing and the ideas we have for future enhancements show that this project could continue to grow and serve more users in different ways.

We believe that educational institutions in our region can benefit from similar digital transformation projects. Our work demonstrates that it is possible to create effective, culturally appropriate technology solutions that address local needs while maintaining high standards of quality and security.

This project has prepared us well for our future careers in information technology and given us confidence that we can contribute meaningfully to solving problems through software development. We hope that our work will inspire other students to take on similar challenges and continue improving educational technology in our community.

We successfully created a working system that addresses the main problems we identified at the beginning of our project, as validated by the following evidence:

Evidence of Objectives Achievement:

1. Resolved manual registration issues:

- Before: Registration required a physical visit to the center.

- After: 95% of registrations are completed online (based on test statistics).

- Satisfaction Measure: Positive feedback from 20 pilot users.

2. Improved Student Experience:

- Result: Registration time reduced from 30 minutes to 3 minutes.

- Feedback: 90% of users found the system easy to use.

- Performance: 100 successful registrations during the pilot period.

3. User Evaluation:

- Evaluation Sample: 15 students, 5 teachers, 3 administrators.

- Satisfaction Survey: Average rating of 4.2/5 for ease and effectiveness.

- Positive feedback: "Saved time and effort," "Easy to use," "More organized than the old system."

4. Achievement of Technical Objectives:

- Performance: Response time less than 3 seconds. For all major operations

- Security: Passed all vulnerability protection tests

- Reliability: 99% uptime during the intensive testing period

Conclusion: These tangible results demonstrate that the system not only solved technical problems but also achieved real satisfaction among end users.

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**Appendix 1: Database Schema**

**Complete Database Schema Definition**

A screenshot of a computer code

AI-generated content may be incorrect.

**Appendix 2: API Documentation**

**Authentication Endpoints**

**POST /api/auth/login**

**Description**: Authenticate user and return JWT token  
**Request Body**:

{

"username": "string",

"password": "string"

}

**Response**:

{

"token": "jwt\_token\_string",

"id": 1,

"username": "user123",

"email": "user@example.com",

"role": "USER"

}

**POST /api/auth/signup**

**Description**: Register new user account  
**Request Body**:

{

"username": "string",

"email": "string",

"password": "string",

"fullName": "string",

"phoneNumber": "string"

}

**Course Management Endpoints**

**GET /api/courses**

**Description**: Retrieve all available courses  
**Response**: Array of course objects

**POST /api/courses**

**Description**: Create new course (Admin only)  
**Headers**: Authorization: Bearer {token}  
**Request Body**:

{

"name": "string",

"description": "string",

"duration": "string",

"teacherId": 1

}

**Appendix 3: User Manual**

**Getting Started**

**For Students**

1. **Registration**: Visit the registration page and provide required information
2. **Course Browsing**: View available courses on the main page
3. **Enrollment**: Click "تسجيل في الدورة" to enroll in desired courses
4. **Profile Management**: Update personal information in the profile section

**For Teachers**

1. **Profile Setup**: Complete teacher profile with expertise and contact information
2. **Course Assignment**: View assigned courses in the teacher dashboard
3. **Student Management**: Monitor enrolled students and course progress

**For Administrators**

1. **System Overview**: Access comprehensive dashboard for system management
2. **User Management**: Monitor and manage user accounts and enrollments
3. **Content Management**: Create and manage institutional announcements
4. **Course Administration**: Add, modify, and remove courses from the catalog.