MCA Semester – IV Project

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A study on Creating Intelligent Recommendation System for Online Learning

Research Project submitted to Jain Online (Deemed-to-be University)

In partial fulfillment of the requirements for the award of

Master of Computer Applications

Submitted by

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Under the guidance of

Prof. Asha Rani M

(Project Professor)

DECLARATION

I, *Rutvik Pathak,* hereby declare that the Research Project Report titled *"Intelligent Recommendation System for Online Learning" has been* prepared by me under the guidance of *Prof. Asha Rani M.* I declare that this Project work is towards the partial fulfillment of the University Regulations for the award of degree of Master of Computer Applications by Jain University, Bengaluru. I have undergone a project for a period of Eight Weeks. I further declare that this Project is based on the original study undertaken by me and has not been submitted for the award of any degree/diploma from any other University / Institution.

Place: Bengaluru

Rutvik Pathak - 221VMTR00777

Date: 2nd June 2024

CERTIFICATE

This is to certify that the Project report submitted by Mr./Ms. *Rutvik Pathak* bearing *221VMTR00777* on the title *"Intelligent Recommendation System for Online Learning"* is a record of project work done by him/ her during the academic year 2023-24 under my guidance and supervision in partial fulfilment of Master of Computer Applications.

Place: Bangalore

Date: 2nd June 2024

Prof. Asha Rani M

ACKNOWLEDGEMENT

I extend my deepest gratitude to my organization guide, Prof. Asha Rani M, for her invaluable guidance, support, and encouragement throughout this project. My sincere thanks go to the officials of Jain University for providing a conducive environment for academic pursuits. I am also grateful to the esteemed faculty members whose expertise and insights greatly contributed to the project's success. Additionally, I appreciate the support from my peers and everyone else who assisted in any capacity. Their collective efforts and unwavering assistance have been instrumental in the successful completion of this project. I am profoundly grateful for their contributions.

Thank You,

Rutvik Pathak - 221VMTR00777

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Executive Summary

This project focuses on developing a detailed career road map for users interested in five key IT fields: Software Development, DevOps, Network Security, Database Administration, and Software Testing. The main objective is to create a Smart Recommendation System that leverages advanced technology to tailor course suggestions based on individual user preferences and career aspirations. This system will simplify the process of identifying and selecting the right online courses, thereby enhancing the learning experience and supporting career advancement.

The core of our project is a smart system designed to personalize the learning journey for each user. By analyzing user preferences, career goals, and learning history, the system will recommend the most relevant courses and certifications needed for their chosen IT field. This personalized approach ensures that learners spend their time and resources on courses that directly align with their career objectives, thereby optimizing their educational outcomes.

A significant part of our mission is to improve access to free online courses. These courses are often hidden among numerous paid options, making them difficult to find. Our system will highlight these free resources, ensuring that users can easily discover and access a wide range of learning opportunities without financial barriers. By emphasizing the availability of high-quality free courses, we aim to democratize education and empower learners from all financial backgrounds.

Many learners struggle with knowing where to start, how to progress, and the estimated time commitment required for their education. To address this, our project will provide comprehensive guides and timelines for each recommended course and certification path. These guides will include step-by-step instructions, prerequisites, course durations, and expected outcomes, giving learners a clear understanding of their educational journey. This structured approach will help learners navigate their path with confidence, avoid unnecessary delays, and make informed decisions about their learning.

Detailed Career Road Maps

- **Software Development:**
  - Key Courses: Programming Languages (e.g., Python, Java), Software Engineering, Data Structures and Algorithms, Web Development, Mobile App Development.
  - Certifications: Microsoft Certified: Azure Developer Associate, Oracle Certified Professional: Java SE Programmer, Certified ScrumMaster (CSM).

- **DevOps:**
  - Key Courses: Linux Essentials, Cloud Platforms (AWS, Azure), CI/CD Tools (Jenkins, Docker), Infrastructure as Code (Terraform), Automation (Ansible).
  - Certifications: AWS Certified DevOps Engineer, Google Professional DevOps Engineer, Docker Certified Associate (DCA).

- **Network Security:**
  - Key Courses: Networking Fundamentals, Cybersecurity Essentials, Ethical Hacking, Firewalls and VPNs, Incident Response.
  - Certifications: Certified Information Systems Security Professional (CISSP), CompTIA Security+, Certified Ethical Hacker (CEH).

- **Database Administration:**
  - Key Courses: Database Design, SQL Programming, Oracle Database Administration, NoSQL Databases, Data Warehousing.
  - Certifications: Oracle Certified Professional, MySQL Database Administrator, Microsoft Certified: Azure Data Engineer Associate.

- **Software Testing:**
  - Key Courses: Software Testing Fundamentals, Test Automation, Performance Testing, Security Testing, Agile Testing.
  - Certifications: ISTQB Certified Tester, Certified Software Test Professional (CSTP), Selenium Certification.

By integrating these objectives, our project aims to provide a comprehensive and user-friendly system that enhances the accessibility and effectiveness of online learning. The Smart Recommendation System will not only guide users to the right courses but also ensure that free resources are prominently featured and that learners have clear, actionable paths to follow. This holistic approach will support individuals in achieving their career aspirations in the IT sector, making learning more accessible, enjoyable, and effective.

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1. **Learner Table:**
    - Stores information about the learners.
    - Columns: LearnerID (Primary Key), Name, Email, Password, etc.

2. **ITFields Table:**
    - Contains the different IT fields.
    - Columns: FieldID (Primary Key), FieldName (e.g., Software Developer, DevOps, Network Security, Database Administration, Software Tester).

3. **Courses Table:**
    - Lists all the courses related to each IT field.
    - Columns: CourseID (Primary Key), CourseName, FieldID (Foreign Key), Description, URL, IsFree (Boolean), Duration.

4. **Certifications Table:**
    - Lists all certifications for each IT field.
    - Columns: CertificationID (Primary Key), CertificationName, FieldID (Foreign Key)

5. **LearnerCourses Table:**
    - Tracks the courses each learner is enrolled in and their completion status.
    - Columns: LearnerCourseID (Primary Key), LearnerID (Foreign Key), CourseID (Foreign Key), Status (e.g., Enrolled, Completed).

6. **LearnerCertifications Table:**
    - Tracks the certifications each learner is pursuing and their completion status.
    - Columns: LearnerCertificationID (Primary Key), LearnerID (Foreign Key), CertificationID (Foreign Key), Status (e.g., Pursuing, Achieved).

7. **LearnerFields Table:**
    - Tracks the IT fields each learner is interested in.
    - Columns: LearnerFieldID (Primary Key), LearnerID (Foreign Key), FieldID (Foreign Key).

CHAPTER 1

INTRODUCTION, SCOPE AND BACKGROUND

1. INTRODUCTION, SCOPE AND BACKGROUND

1.1 Overview of Project Case / Business case

The IT industry is characterized by its fast-paced evolution and the continuous emergence of new technologies and methodologies. As a result, aspiring IT professionals often face challenges in identifying the most relevant skills and certifications required for their desired career paths. Additionally, the abundance of available courses, both paid and free, can be overwhelming, leading to confusion and inefficiency in the learning process.

ELearn aims to address these challenges by developing a Smart Recommendation System that provides a clear and structured career roadmap for users interested in five key IT fields: Software Development, DevOps, Network Security, Database Administration, and Software Testing.

1.2 Problem definition

Learners are often overwhelmed by the vast array of course options, struggling to identify the most relevant and beneficial ones due to the absence of a structured recommendation system, leading to inefficiency and confusion in the learning process.

The existing platform lacks advanced personalization features, failing to account for individual learner preferences, career goals, or learning histories, resulting in generic recommendations that may not align with each learner's unique needs.

Free courses, which are invaluable for learners with financial constraints, are often overshadowed by paid options, restricting access to high-quality educational resources for many users. This lack of visibility hinders the ability of learners to access valuable resources that could aid in their educational journey.

Learners are often left without clear guidance, unsure about where to start, which courses to take, and the time required to complete their educational goals. The current system does not provide detailed guides or timelines, leaving them to navigate their educational paths without sufficient direction, which can lead to frustration and decreased motivation.

1.3 Project Scope

ELearn aims to revolutionize online learning by enhancing personalization, increasing accessibility, and providing clarity. The platform will offer a tailored learning experience by recommending courses and certifications based on individual preferences, career goals, and learning history. Advanced algorithms and machine learning techniques will continuously adapt to each learner's unique needs, providing a bespoke experience that fosters growth and success. Additionally, it will improve the visibility of free courses, ensuring that learners have access to high-quality educational resources regardless of their financial situation. This inclusive approach will bridge the gap for learners who may have previously been excluded, ensuring equal opportunities for upskilling and reskilling. Finally, clear step-by-step guides and timelines will help learners navigate their educational journey with confidence.

CHAPTER 2
REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1 Literature Review

The IT industry evolves rapidly, making it hard for professionals to keep up with the required skills and certifications. Smart Recommendation Systems can help by providing personalized learning pathways that cater to individual needs.

2.1.1. Relevant Literature:

Studies show the effectiveness of recommendation systems in education. For instance, Pazzani and Billsus (2007) discuss how Netflix and Amazon use machine learning algorithms to create personalized recommendations based on user preferences, which can be applied similarly in educational contexts. Ricci, Rokach, and Shapira (2015) provide a comprehensive overview of recommender systems, highlighting how platforms like Coursera and Udacity use these systems to tailor course recommendations. Recent advancements in AI and data analytics have further improved these systems. Techniques like collaborative filtering, used by Spotify to recommend music based on listening history, and hybrid recommender systems, used by YouTube to suggest videos, enhance the accuracy and relevance of recommendations.

2.1.2. Evaluation of Literature in Relation to Project Tasks:

The literature highlights the need for personalization in educational platforms. For example, Khan Academy uses personalized dashboards to help students track their learning progress. Similarly, ELearn's project aligns with these findings by aiming to provide personalized career roadmaps in key IT fields, addressing current gaps such as lack of guidance and visibility of free courses. By integrating advanced algorithms and machine learning techniques, ELearn aims to emulate the success seen in these other platforms.

2.1.3. Approach to Solve the Problem:

ELearn will use a hybrid recommendation approach, combining collaborative filtering, content-based filtering, and machine learning algorithms. For instance:

- **Collaborative Filtering:** Like how Amazon recommends products based on similar user purchases, ELearn will suggest courses based on the learning paths of users with similar career goals.
- **Content-Based Filtering:** Similar to how LinkedIn Learning recommends courses based on the skills and interests listed in user profiles, ELearn will match courses to individual career objectives and learning histories.
- **Machine Learning Algorithms:** Just as Netflix's recommendation engine evolves with user preferences and viewing habits, ELearn's system will dynamically adjust recommendations using continuous feedback to ensure a bespoke learning experience.

2.2 Feasibility Analysis

2.2.1. SWOT Analysis

Strengths:

- Highly personalized learning experience.
- Advanced algorithms and machine learning techniques.
- Increased visibility of free courses, promoting inclusivity.

Weaknesses:

- Initial setup and data collection phase might be time-consuming.
- Requires continuous updating to remain relevant with technological advancements.

Opportunities:

- Expanding into additional IT fields and other industries.
- Partnering with educational institutions for certification pathways.

Threats:

- Competition from existing e-learning platforms with similar features.
- Rapid technological changes necessitating frequent updates to the system.

2.2.2. Business Value:

- Enhanced Platform Value: Provides personalized learning experiences.
- Broader User Base: Attracts users with financial constraints by highlighting free courses.
- Inclusive Environment: Fosters inclusivity and accessibility

2.2.3. Technical Feasibility:

- Existing Technologies: Utilizes machine learning, data analytics, and cloud computing.
- Technical Infrastructure: Includes scalable databases and real-time data processing.
- High Performance: Ensures reliability with advanced algorithmic models.

2.2.4. Cost-Benefit Analysis:

- Estimated Costs: Development and implementation, Ongoing maintenance and updates, Marketing and user acquisition.
- Benefits: Increased user engagement and retention,Higher course enrollment conversion rates, Broader reach and inclusivity, expanding the user base.

2.2.5. Operational Feasibility:

- Seamless Integration: Designed to work smoothly with the existing platform.
- User-Friendly: Interfaces and navigation enhance user experience.
- Data Security: Backend systems ensure data privacy and security.

2.2.6. Ethical Feasibility:

- Data Privacy: Ensures user data protection.
- Unbiased Recommendations: Provides fair and transparent suggestions.
- Industry Standards: Adheres to ethical practices and regulations in e-learning

CHAPTER 3
PROJECT PLANNING AND METHODOLOGY

3. PROJECT PLANNING AND METHODOLOGY

3.1 Project Planning

- **Revised Gantt Chart**

Task ID	Task Name	Start Date	End Date	Duration (Days)	Dependencies
1	Project Initiation	01/06/2024	03/06/2024	3	
2	Requirement Gathering	04/06/2024	10/06/2024	7	1
3	Design Phase	11/06/2024	20/06/2024	10	2
4	Development Phase	21/06/2024	15/08/2024	30	3
5	Testing Phase	16/08/2024	29/08/2024	5	4
6	Project Closure	07/09/2024	10/09/2024	4	5

- **Communication Plan**

Communication Type	Description	Frequency	Responsible Party
Project approval	Initial meeting to discuss project scope, objectives, and timeline	Once	Project Lead
Project Update	Progress updates on tasks, milestones, and issues	Weekly	Project Lead

- **Resource Plan**

Resource	Role	Duration
VS code	Oversees project planning and execution	Entire project
Codepen	Designs the user interface and experience	Design Phase
Office 365	Gathers and documents project requirements	Documentation Phase
MySQL Workbench	Designs the user interface and experience	Storage Phase
Github	Deploy the project and try to execute in running state	Deployment Phase
Google Chrome	Conducts testing to ensure quality and functionality	Testing Phase

- **Risk Management Plan**

Risk	Description	Probability	Impact	Mitigation Strategy
Resource Availability	Key resources unavailable when needed	High	High	Plan resource allocation, have backup resources
Technical Challenges	Issues with technology integration or performance	Medium	High	Pivot the plan and take basic approach
Delayed Deliverables	Tasks taking longer than planned	Medium	High	Monitor progress regularly, adjust timelines if needed

3.2 Methodology

3.2.1. Type of Methodology

- Waterfall Methodology: The Waterfall methodology is a linear and sequential approach to project management. Each phase must be completed before the next one begins, making it simple to understand and manage. This approach is well-suited for projects with clear, unchanging requirements. However, it is inflexible to changes, and issues may be discovered late in the process, making it less ideal for projects with high uncertainty or evolving requirements.
- Agile Methodology: The Agile methodology is an iterative and incremental approach that focuses on collaboration, customer feedback, and small, rapid releases. It offers flexibility to changes, early detection of issues, and continuous user involvement and feedback. However, it requires high user involvement, can lead to scope creep, and has less predictability in terms of time and cost.
- Scrum Framework: The Scrum framework is a subset of Agile that delivers a product in iterative cycles called sprints. It enhances team collaboration, provides regular feedback, and is flexible and adaptive. However, it requires experienced team members, daily meetings can be burdensome, and there is a risk of incomplete sprints.
- Lean Methodology: The Lean methodology focuses on delivering value to the customer through efficient use of resources and eliminating waste. It maximizes resource utilization, improves quality and efficiency, and is customer-focused. However, it can be challenging to implement, and requires a cultural change within the organization.

3.2.2. Chosen Methodology: Agile

3.2.3. Rationale for Choosing Agile:

- Flexibility and Adaptability: Given the fast-paced evolution of the IT industry, Agile allows for flexibility to adapt to new technologies and changing requirements.
- User-Centric Approach: Continuous user feedback ensures that the developed recommendation system meets the needs and expectations of learners.
- Early and Continuous Delivery: Agile's iterative process allows for early and continuous delivery of valuable functionalities, providing immediate benefits to users and stakeholders.
- Risk Mitigation: By identifying issues early through iterative testing and user feedback, risks are mitigated more effectively compared to other methodologies.

CHAPTER 4
DATA ANALYSIS, DESGN AND IMPLEMENTATION

4. DATA ANALYSIS, DESIGN AND IMPLEMENTATION

4.1 Requirement Analysis

4.1.1. Data Collection

Data collection is crucial for any project, and for your educational project, it involves gathering data from primary and secondary sources to support the development of the Smart Recommendation System.

- Primary Data Collection: Gathering user information such as full name, email address, field of interest, and feedback/suggestions through online surveys and structured interviews with potential users and educational experts.

- Secondary Data Collection: Collecting data on courses and certifications in the chosen field from existing databases and educational websites, including course descriptions, user reviews, ratings, and certification details.

4.1.2. Data Preprocessing

- Cleaning and formatting the collected data to prepare it for analysis and model training.
- Algorithm Selection: Choosing appropriate machine learning algorithms or recommendation systems based on the collected data and project requirements.
- Model Training: Training the recommendation system model using the cleaned data and selected algorithms.
- Evaluation: Evaluating the model's performance using metrics like precision, recall, and F1-score to ensure accurate recommendations.
- Deployment: Deploying the recommendation system into a production environment, making it accessible to users.
- User Testing: Conducting user testing to gather feedback and ensure that the system meets user expectations.
- System Maintenance: Regularly updating and maintaining the recommendation system to adapt to changing user preferences and course offerings.

4.1.2 Data Analysis and tools of data analysis

Tools of Data Analysis

- Descriptive statistics
    - Descriptive statistics are used to summarize user data
    - Summarize the distribution of users based on age and gender using counts or percentages.
    - Describe how users prefer to learn based on survey responses or interaction data.
    - Calculate the mean, median, mode, and standard deviation of course completion rates to understand how many users finish the courses.
- Inferential statistics
    - Inferential statistics are used to draw conclusions and make predictions based on data
    - Conduct hypothesis tests to determine if there are significant differences in learning progress between different user groups.
    - Create confidence intervals around completion rates of recommended courses to estimate the range in which the true completion rate lies.
- Data visualization
    - Data visualization is used to present data visually
    - Visualize trends in user registration and login over time using line charts or heatmaps to identify patterns.
    - Create bar charts or pie charts to display the most recommended courses or certifications based on user ratings or usage metrics.
    - Use scatter plots to show correlations between user preferences and course recommendations to understand user behavior.
- Machine learning algorithms
    - Machine learning algorithms are used for predictive analytics
    - Build recommendation systems using collaborative filtering or content-based filtering to suggest courses and certifications based on user preferences and past behaviors.
    - Use classification algorithms like Decision Trees or Random Forests to predict user satisfaction with recommended courses based on historical data.
    - Cluster users based on their learning objectives and preferences to identify segments with similar learning goals using clustering techniques
- Data mining techniques
    - Use K-means clustering to group users into clusters based on their learning objectives and progress.
    - Build decision trees to understand which factors influence user decisions when selecting courses.
    - Use association rule mining to identify patterns in the sequence of courses taken by users to recommend additional courses.

Technical Requirements

- Hardware specifications : 8GB RAM, Intel i5 7th generation, 500 GB SSD
- Software specifications 64-Bit Windows 10, VS Code, MySQL Workbench, Github.

Functional Requirements

- User registration and login:
    - Allows registered users to log in to the system.
    - Lerner navigates to the login page.
    - Lerner enters their username/email and password.
    - System verifies the credentials and grants access to the
    - learner's account.
    - Lerner gains access to the system's features
    - and functionalities.
- Course and certification recommendations
    - System generates a personalized roadmap with recommended courses, certifications, and milestones.
- Progress tracking and analytics
    - Lerner selects the desired IT field(s) for which they want to create a roadmap.
    - Lerner specifies their learning objectives, goals, and preferences.

Non-Functional Requirements

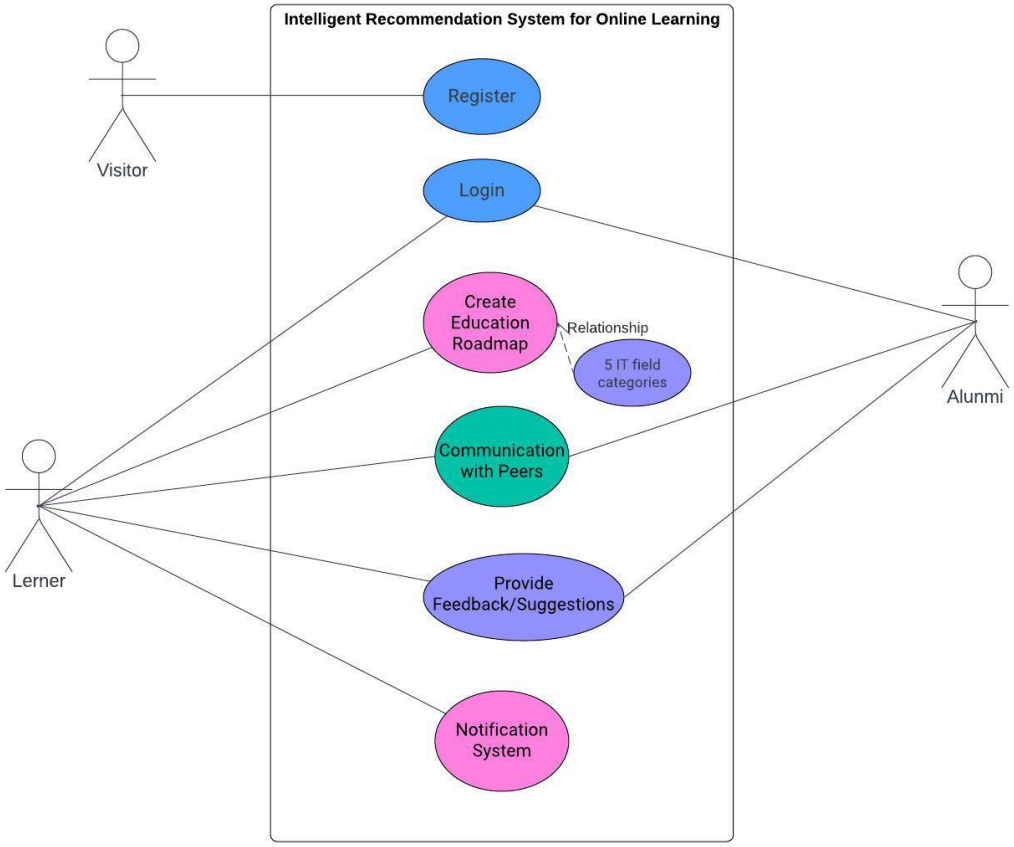
- **Performance** Response time: The system shall respond to user login attempts within 2 seconds.
- **Security** Data privacy: User credentials and personal information shall be stored securely in an encrypted format.
- **Usability** User experience: The login and registration processes shall be intuitive and user-friendly.
- **Maintainability** Scalability: The system architecture shall support scaling up to accommodate 10,000 concurrent users.
- **Design constraints** Compatibility: The system shall be compatible with the latest versions of Chrome, Firefox, Safari, and Edge browsers.

4.1.3. Design

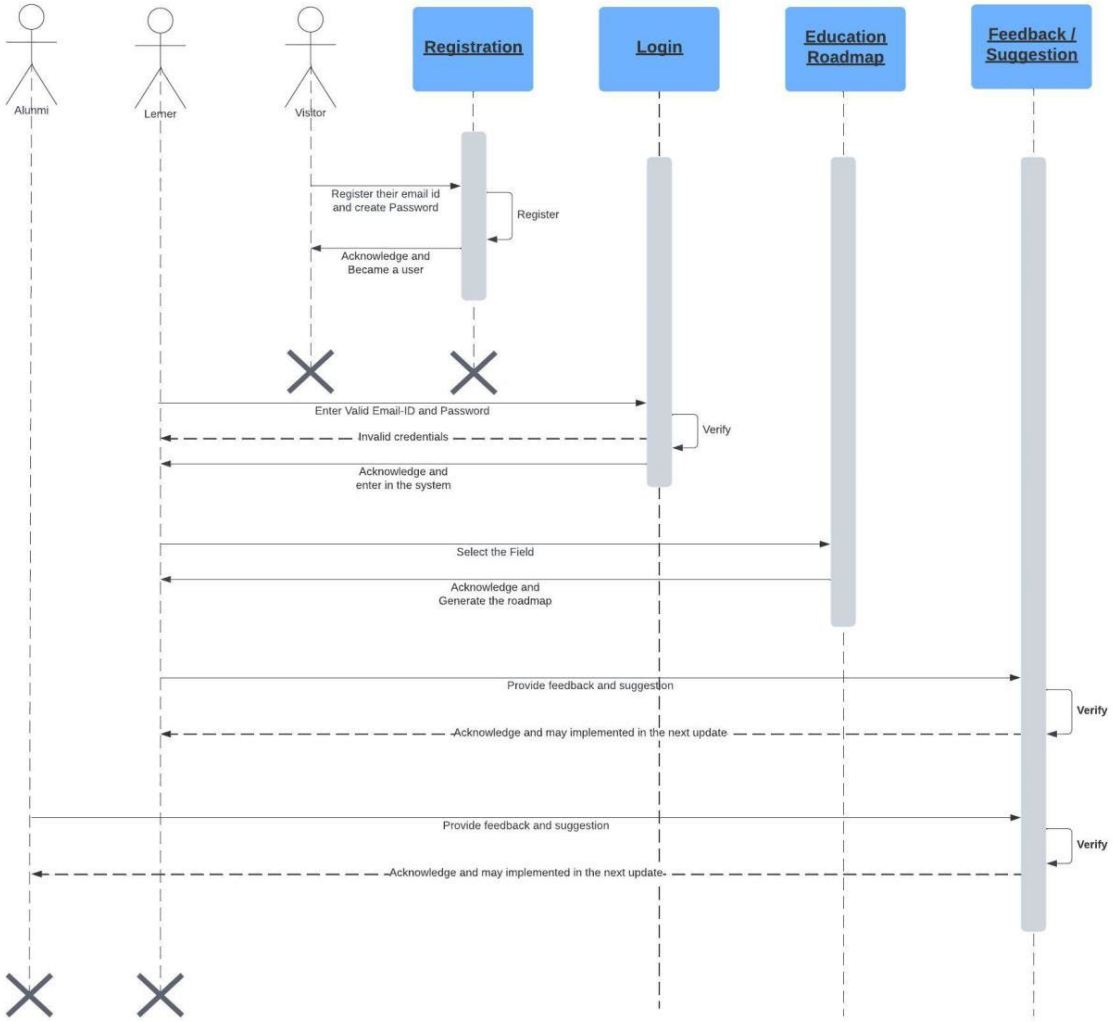
- Logic Design:
  Define the logic for generating and updating the learner's progress, milestones, and achievements based on completed courses and certifications.
- Data Design:
  - User: UserID (PK), Username, Email, Password, Role
  - Course: CourseID (PK), CourseName, Description, Duration, Category
  - Certification: CertificationID (PK), CertificationName, Description, Authority, ValidityPeriod
  - Milestone: MilestoneID (PK), Description, CompletionDate
  - Progress: ProgressID (PK), UserID (FK), CourseID (FK), CertificationID (FK), MilestoneID (FK), ProgressPercentage
- Interface Design
  - Login Page: Username/Email, Password, Login button
  - Registration Page: Username, Email, Password, Confirm Password, Register button
  - Dashboard: Recommended Courses and Certifications, Progress Overview, Analytics
  - Course Recommendation Page: Personalized roadmap with recommended courses and certifications
  - Progress Tracking Page: IT Field selection, Learning Objectives, Goals, Save button

- Diagram and Layout:

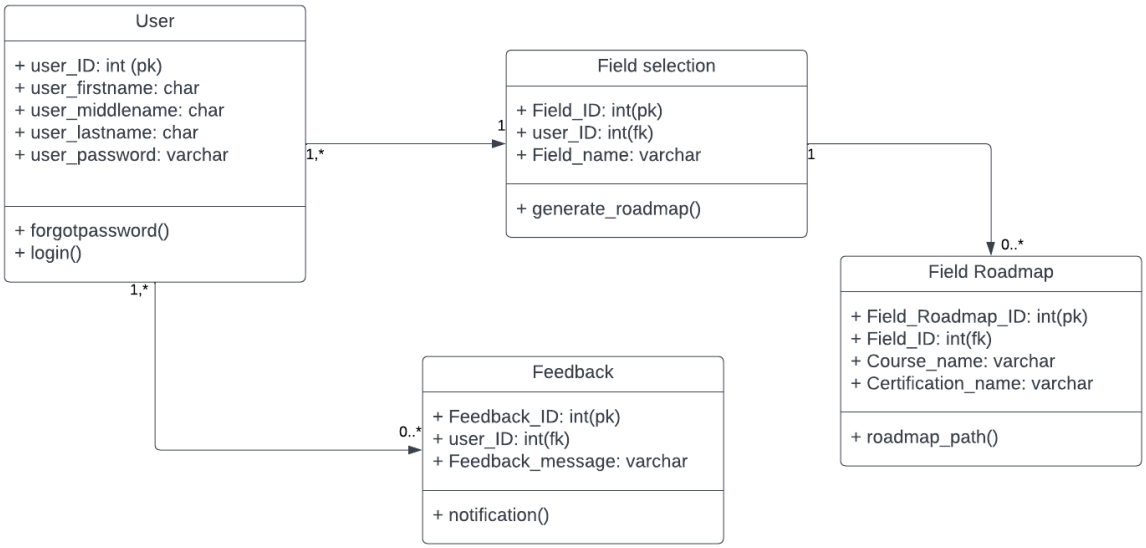
Use-Case Diagram



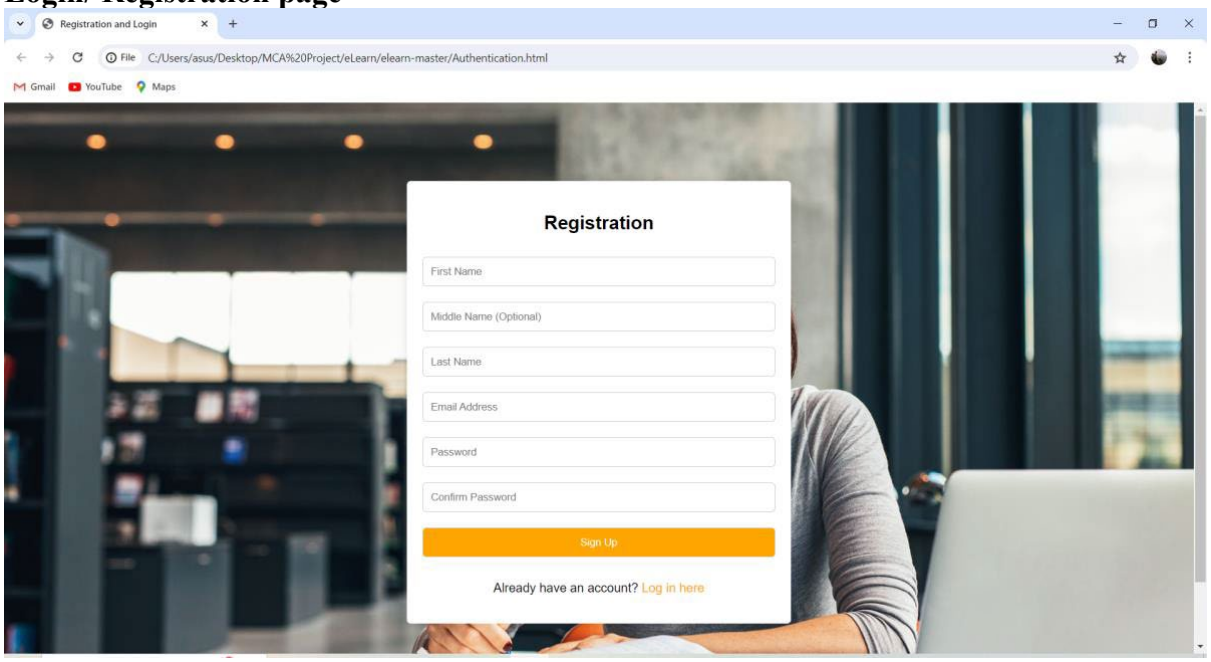
Sequence Diagram:

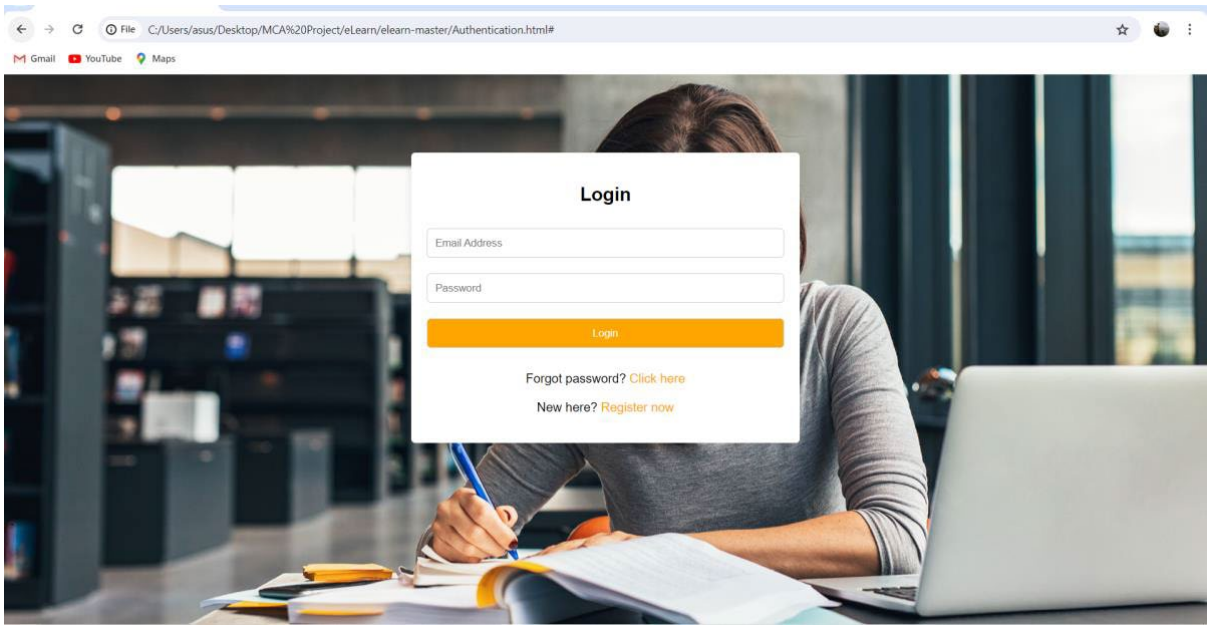


Class Diagram

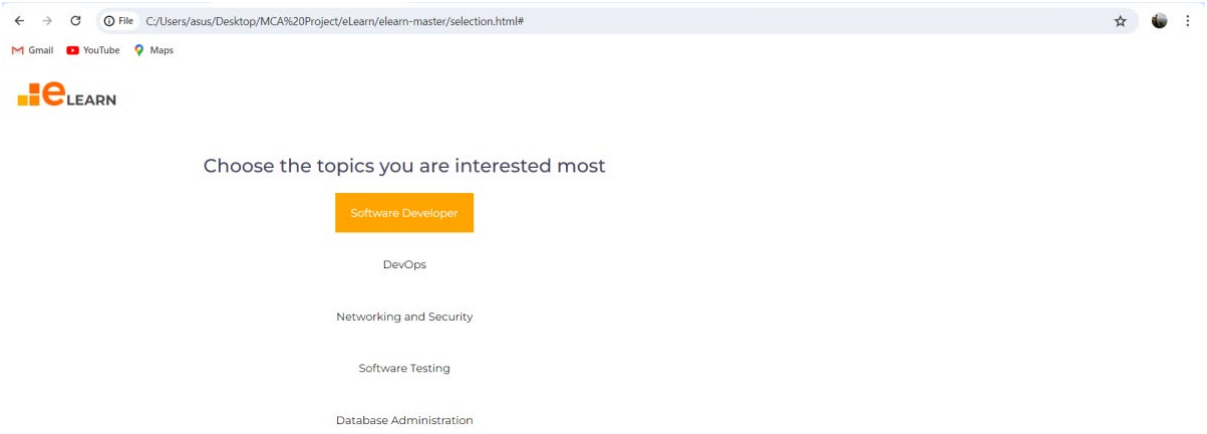


Login/ Registration page

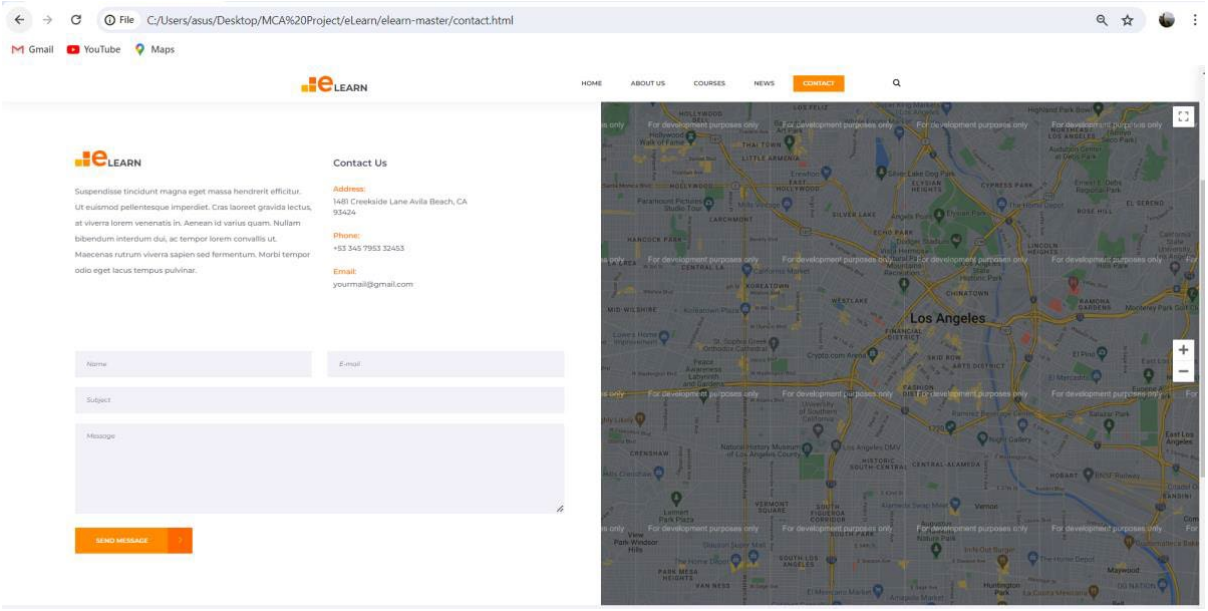




Career Path



Contact Us



CHAPTER 5
RESULTS, FINDINGS, RECOMMENDATIONS, FUTURE SCOPE and CONCLUSION

5. RESULTS, FINDINGS, RECOMMENDATIONS, FUTURE SCOPE and CONCLUSION

5.1 Results of the work

The Intelligent Education recommendation system has been successfully developed and implemented. It allows registered users to log in securely to the system. Users navigate to the login page, where they enter their username/email and password. The system verifies the credentials and grants access to the learner's account. Once logged in, learners gain access to the system's features and functionalities, including personalized course and certification recommendations, progress tracking, and analytics.

5.2 Findings based on analysis of data

The analysis of data from the Interlegent Education recommendation system reveals significant insights into user engagement and learning patterns. Users are provided with a personalized roadmap that includes recommended courses, certifications, and milestones based on their selected IT fields, learning objectives, goals, and preferences. This personalized approach enhances user satisfaction and encourages continued engagement with the platform.

5.3 Recommendation based on findings

Based on the findings, it is recommended to further enhance the system's recommendation algorithms to improve the accuracy and relevance of course and certification recommendations. Additionally, integrating machine learning models can help predict future learning needs based on user behavior and feedback. These enhancements will ensure that the system continues to provide valuable and tailored recommendations to its users.

5.5 Suggestions for areas of improvement

Moving forward, there are several areas for improvement for the Interlegent Education recommendation system. Firstly, enhancing the user interface and experience can make navigation more intuitive and user-friendly. Secondly, expanding the database of courses and certifications available in different IT fields can provide users with more diverse options. Finally, implementing real-time progress tracking and analytics features can offer users immediate feedback on their learning journey, enhancing their overall experience.

5.6 Scope for future work

In the future, the Interlegent Education recommendation system could be expanded to include additional functionalities. For instance, integrating social learning features such as discussion forums and peer collaboration can foster a sense of community among users. Furthermore, exploring partnerships with industry experts and organizations to offer exclusive certifications and learning opportunities can enhance the system's credibility and value proposition. Continuous research and development will be essential to keep the system up-to-date with evolving industry trends and learner needs.

5.7 Conclusion

In conclusion, the Interlegent Education recommendation system has successfully achieved its primary objectives of providing personalized course and certification recommendations, progress tracking, and analytics for learners in various IT fields. The system's ability to generate a personalized roadmap based on user preferences and objectives has been well-received, contributing to an enhanced learning experience. Moving forward, focusing on improving recommendation algorithms, user interface, and expanding the database will further solidify the system's position as a valuable tool for learners.

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