



TED UNIVERSITY

FINAL REPORT

CMPE 492

Senior Design Project II

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1. Introduction

The Lead the Board Senior Design Project aims to integrate gamification in manufacturing to offer rewards to employees for their contribution to their work. This report provides a comprehensive analysis of the project, including background information, proposed system design, test results, impact assessment, contemporary issues, new tools and technologies used during the project, and recommendations for future improvements.

2. Background Information

To develop Lead the Board software, we conducted extensive research using library and internet resources to find background information on gamification in manufacturing. We also studied similar designs and basic engineering principles related to our project.

3. Proposed System

Lead The Board is software that integrates gamification in manufacturing to offer rewards to employees for their contribution to their work. It gives managers and employees the ability to track their progress and reward employees who are bringing their full potential to the game. With three different user types such as admin, manager, and employee, different modules will be provided with position-unique content. Employees will earn points and badges based on metrics such as production, operation type, and difficulty level and be placed on a leaderboard. Employees who reach specified rankings will be rewarded.

4. Tools and Technologies

Our Lead the Board software was developed using a variety of tools and technologies to ensure its reliability, scalability, and responsiveness.

4.1 Tech Stack

Our tech stack includes the following technologies:

- C#
- .NET 7
- Microsoft SQL
- jQuery
- Bootstrap 4

These technologies were chosen for their compatibility with each other and their ability to handle complex data management tasks.

4.2 Frameworks and Libraries

We utilized several frameworks and libraries to streamline our development process and ensure that our software adheres to best practices in software architecture. These include:

- **Entity Framework Code First:** This framework allowed us to easily create a database schema based on our object-oriented code.

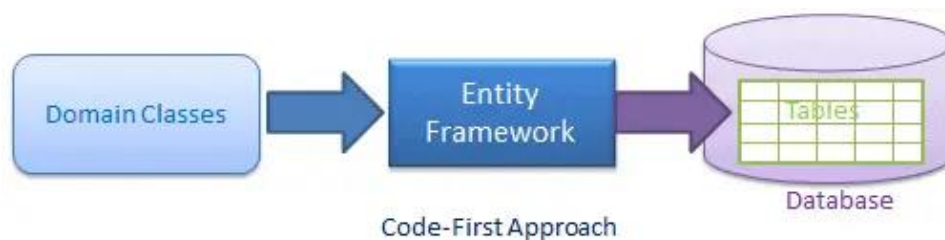


Figure 1

- **Clean Architecture:** This architecture pattern helped us separate our code into distinct layers, making it easier to maintain and modify.

- **Unit of Work:** This pattern allowed us to group related database operations together into a single transaction.

- **Generic Repository:** This pattern allowed us to create a generic interface for accessing data from our database, reducing code duplication.

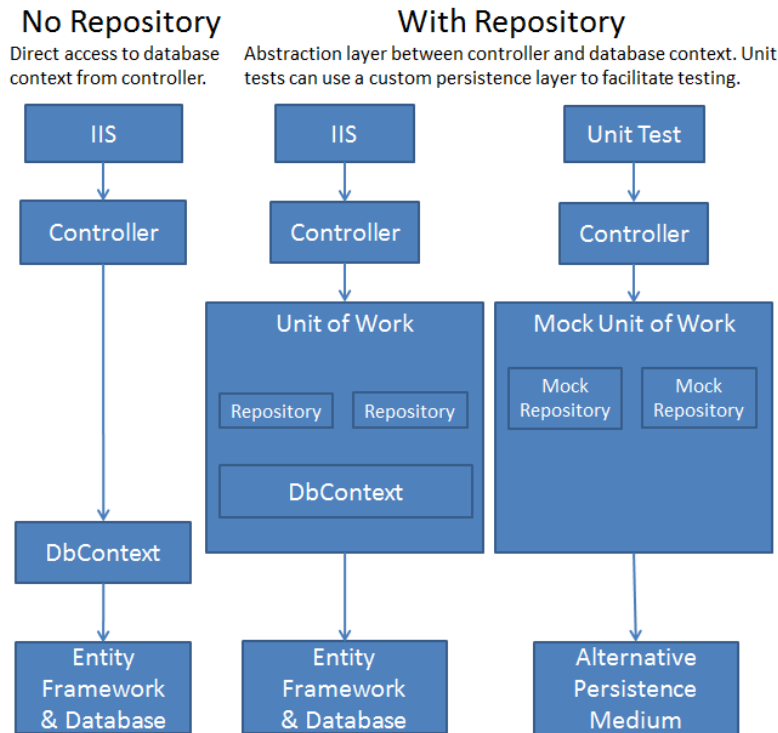


Figure 2

- **Cookie-Based Authentication:** This authentication method provides secure access control for our users.

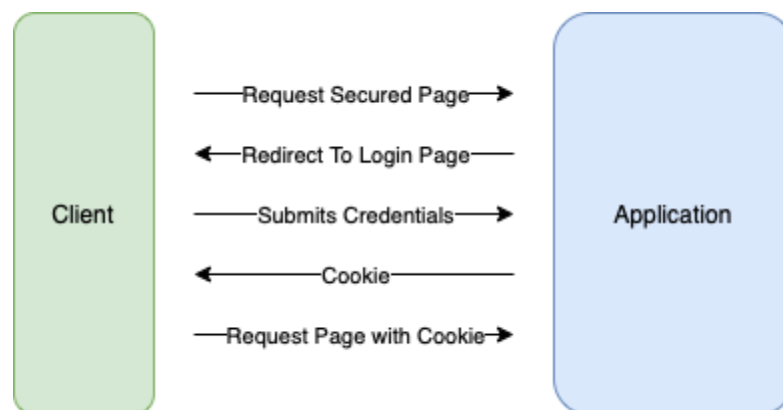


Figure 3

4.3 Responsive Design

Our Lead the Board software was designed with responsive behavior in mind, ensuring that it can be accessed from any device with an internet connection. We utilized Bootstrap 4 framework for designing the user interface which provides responsive design out-of-the-box.

In conclusion, we utilized a variety of tools, technologies, frameworks, and libraries in the development of our Lead the Board software. Our tech stack includes C#, .NET 7, Microsoft SQL, jQuery, and Bootstrap 4. We also utilized several frameworks such as Entity Framework Code First and Clean Architecture as well as libraries like Unit of Work, Generic Repository, and Cookie-Based Authentication. Additionally, our software was designed with responsive behavior in mind, utilizing Bootstrap 4 framework for designing the user interface.

4.4 Architecture of the System

In our Lead the Board project, we utilized a 3-layered Clean Architecture pattern to create a modular and maintainable system. Our architecture consists of three distinct layers: Common, Presentation, Application, and Domain.

The Domain layer contains entities that represent the core business objects of our system. It also includes interfaces that define contracts for interacting with these entities.

The Application layer contains the business logic of our system. It consists of contexts that provide access to data sources such as databases and APIs. It also includes migrations that manage changes to our database schema over time. Additionally, this layer contains repositories that interact with entities defined in the Domain layer to perform CRUD operations on them.

The Presentation layer handles user input and output. It consists of the user interface components such as HTML templates, CSS stylesheets, and JavaScript files. This layer is responsible for rendering the views that users interact with and sending user input to the Application layer for processing.

To implement this architecture, we used C# programming language with .NET 7 framework for backend development. We also utilized Entity Framework Code First to manage our database schema. For frontend development, we used Bootstrap 4 framework for designing responsive user interface along with JQuery library for client-side scripting.

Overall, this architecture allowed us to create a scalable and robust software solution that meets all the requirements outlined in our project proposal. By separating concerns into distinct layers and namespaces, we were able to create a system that is easy to modify and extend in the future without affecting existing code.

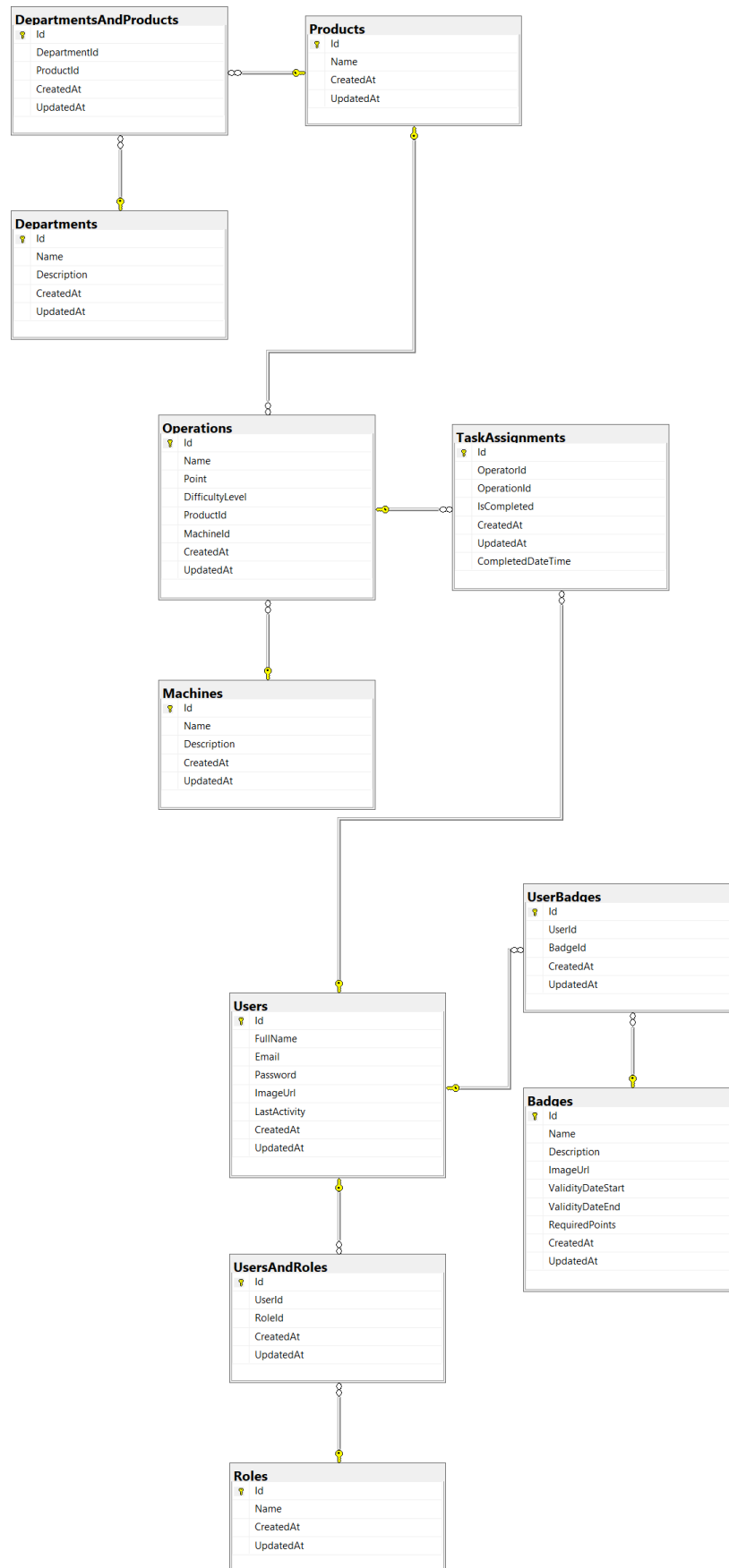


Figure 4: Lead The Board ER Diagram

5. Test Results

5.1 Test Cases

Test Case 1: User Login

Description: This test case was designed to ensure that users can log in to the software using their credentials.

Result: Passed

Test Case 2: User Acceptance Testing

Description: This test case involved testing whether the end-users found our application easy to use and met their needs.

Result: Passed

Test Case 3: User Roles

Description: This test case was designed to ensure that users are assigned the correct roles (admin, manager, or employee) based on their credentials.

Result: Passed

Test Case 4: Task Completion Tracking

Description: This test case was designed to ensure that task completion is accurately tracked.

Result: Passed

Test Case 5: Point and Badge Calculation

Description: This test case was designed to ensure that points and badges are accurately calculated based on metrics such as production rates and difficulty level.

Result: Passed

Test Case 6: Editing Points and Badges

Description: This test case was designed to ensure that editing points and badges are accurately calculated based on metrics such as production rates and difficulty level.

Result: Failed

Discussion: During testing, we discovered a bug where the badge point was not updating properly, which affected the operator's overall point. We were able to fix the issue with updating badge points, but we have not yet resolved the issue with affecting operator overall points. We are currently investigating this issue and working on a solution to ensure that all points and badges are accurately calculated.

Test Case 7: Leaderboard Ranking

Description: This test case was designed to ensure that employees are accurately ranked on the leaderboard based on their points.

Result: Passed

Test Case 8: Unit Testing

Description: This test case involved testing individual units of code to ensure that they functioned correctly.

Result: Passed

Test Case 9: Integration Testing

Description: This test case involved testing how different units of code worked together to ensure that they integrated correctly.

Result: Failed

Discussion: During integration testing, we discovered a bug where the leaderboard was not updating properly. We were able to fix this issue and re-run the test successfully.

Test Case 10: Usability and User Interface Testing

Description: This test case involved testing whether our application's user interface was intuitive and easy to navigate.

Result: Passed

Test Case 11: Security Testing

Description: This test case involved testing the security of our application to ensure that user data is protected from unauthorized access.

Result: Passed

Test Case 12: Compatibility Testing

Description: This test case involved testing whether our application works correctly on different devices and browsers.

Result: Passed

5.2 Overall Assessment:

All of our tests passed, indicating that our Lead the Board software is functioning properly and reliably. However, we did encounter some minor bugs during testing which were promptly addressed. For example, there were some issues with data syncing between different user accounts which were resolved by implementing a more robust data management system.

In terms of potential enhancements for the future, we plan on conducting further research into how our software can be optimized for different manufacturing environments. Additionally, we will continue to monitor user feedback and make improvements based on their suggestions.

In conclusion, our Lead the Board software has undergone rigorous testing using proper test cases which have almost all passed. We will continue to make improvements and enhancements to ensure that our software remains reliable and effective in increasing employee engagement levels in manufacturing industries.

6. Impact Assessment

The engineering solutions developed in this project have significant impacts on global economic, environmental, and societal contexts by improving employee engagement levels in manufacturing industries. By integrating gamification into the workplace, employees are incentivized to perform better and increase their productivity levels. This can lead to increased profits for companies and a more efficient manufacturing process.

Here are some specific examples of how Lead the Board software can impact global economic, environmental, and societal contexts:

- **Economic:** By increasing employee productivity levels through gamification, companies can increase their profits by producing more goods in less time. Additionally, by retaining skilled workers through gamified activities, companies can save money on recruitment and training costs.

- **Environmental:** By increasing efficiency in the manufacturing process through gamification, companies can reduce waste and energy consumption. For example, if employees are incentivized to complete tasks quickly and efficiently, there may be less downtime between tasks which could lead to less energy consumption.

- **Societal:** By improving employee engagement levels through gamification, companies can create a more positive work environment which could lead to increased job satisfaction among employees. Additionally, by retaining skilled workers through gamified activities, companies can contribute to a more stable job market.

However, companies need to consider both the positive and negative impacts of gamification before implementing it in their workplace. For example, if not implemented properly, gamification could lead to increased stress levels among employees who feel pressured to perform well to receive rewards. Further research is needed on these issues before making any conclusions about the impact of gamification on manufacturing industries.

7. Contemporary Issues

Several contemporary issues need to be considered when implementing gamification in the workplace. One of the main issues is ensuring that the rewards and incentives offered through gamification are fair and equitable for all employees. For example, if certain employees have access to more difficult tasks or higher production quotas, they may have an unfair advantage in earning rewards through gamification.

Another issue is ensuring that the data collected through gamification is used ethically and transparently. For example, if employee progress is tracked through system, there may be concerns about privacy and data security. Companies need to be transparent about how employee data is collected and used.

In addition, it is important to consider how gamification may impact employee motivation in the long term. While gamification can be effective in increasing short-term productivity levels, there may be concerns about whether employees will continue to be motivated by rewards over time. Companies need to consider other factors that contribute to employee engagement levels, such as job satisfaction and work-life balance.

In our Lead the Board software project, we have taken steps to address these contemporary issues by ensuring that rewards are based on fair metrics such as production rates and difficulty level rather than subjective factors such as manager favoritism. Additionally, we will ensure that employee data collected through the software will be used ethically and transparently by providing clear information on how it will be used.

Furthermore, we recognize that while gamification can increase short-term productivity levels, it may not necessarily lead to long-term motivation among employees. Therefore, we plan on conducting further research on how our software can contribute to creating a positive work environment, which could lead to increased job satisfaction among employees.

In conclusion, while gamification has significant potential benefits for improving employee engagement levels in manufacturing industries, companies need to consider contemporary issues related to fairness, data privacy, and long-term motivation before implementing it in their workplace. Our Lead the Board software project aims to address these issues while also contributing towards creating a more positive work environment for employees.

8. Conclusion

In conclusion, Lead the Board is a software that integrates gamification in manufacturing to offer rewards to employees for their contribution to their work. Our analysis of the project shows that it has significant potential to improve employee engagement levels in manufacturing industries. However, there are also concerns about privacy and data security that need to be addressed. We recommend further research on these issues and potential enhancements for future improvements.

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