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4/29/2024

# Software Engineering OrionEngine- Ensemble

Group Report

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## Abstract

This report details the creation and development of OrionEngine-Ensemble, a web application designed to handle population-related queries using data from a `world.sql` database. The project was executed by a team of five, utilizing agile methodologies and modern software development tools including Node.js, Express.js, Pug, CSS, and Docker.

## Declaration

I hereby certify that this report constitutes our own work, that where the language of others is used, quotation marks so indicate, and that appropriate credit is given where we have used the language, ideas, expressions, or writings of others.

I declare that this report describes the original work that has not been previously presented for the award of any other degree of any institution.

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## 1.Introduction

The OrionEngine-Ensemble project was initiated to develop a web application designed to efficiently handle population-related queries using data sourced from a comprehensive world.sql database. This application aims to serve as a crucial tool for researchers, policymakers, and educators who require quick access to detailed demographic data. The project was identified as a significant need given the growing importance of data-driven decision-making in both academic and governmental sectors.

## Research Question Addressed

How can we effectively query and display population data in a web application to support academic and governmental research needs?

## Aims

- **To develop a secure and responsive web application** that facilitates efficient querying of population data, considering all data safety.
- **To enhance user engagement** through an intuitive user interface that simplifies complex data queries.

## Objectives

- **Environment Setup:** Establish a robust development environment using Docker to ensure consistency across various systems.
- **Backend Development:** Implement backend services with Node.js and Express.js to manage data retrieval and processing efficiently.
- **Frontend Development:** Design a user-friendly interface using Pug and CSS that provides a seamless user experience.

## Legal, Social, Ethical, and Professional Considerations

Our project adhered to the highest ethical standards concerning data privacy and security. The public and anonymized nature of the database ensured that there were no ethical concerns regarding data misuse. Furthermore, our development practices were designed to ensure the application could be used in a manner that respects user privacy and data integrity.

## Background

In an era where data accessibility can significantly influence societal outcomes, the need for tools that can swiftly interpret and visualize demographic data is more critical than ever. Our team identified a gap in the availability of specialized web applications for demographic research, particularly those that could offer real-time data interactions and visualizations.

## Report Overview

1. **Introduction** - Sets the stage for the project, explaining the need and outlining goals.
2. **Literature or Technology Review** - Discusses technological choices and rationale.
3. **Design and Methodology** - Details the architectural design and development approach.
4. **Implementation and Results** - Describes the implementation process and the results achieved.
5. **Conclusion** - Summarizes achievements, reflects on the learning process, and suggests future work.
6. **References** - Lists all referenced sources.
7. **Appendices** - Includes supplementary materials and project documentation.

## 2.Literature or Technology Review

The choice of technologies such as Node.js, Express.js, and Docker was driven by their widespread use in industry, community support, scalability, and efficiency in handling web application development.

### Node.js

Node.js is an efficient JavaScript runtime built on Chrome's V8 engine, optimized for building scalable network applications. It is ideal for data-intensive applications due to its non-blocking, event-driven architecture. A 2019 study noted its superior performance for real-time applications compared to traditional server-side languages like PHP [1] .

### Express.js

Express.js is a minimalistic web framework for Node.js, facilitating the rapid development of web and mobile applications. It supports numerous middleware packages, making it highly flexible. Literature points to its widespread adoption due to ease of use and efficient routing mechanisms [2] .

### Pug

Pug, a high-performance template engine, simplifies writing HTML and supports dynamic content generation. It reduces HTML code verbosity, enhancing maintainability and scalability. Recent reviews recommend Pug for its simplicity and powerful syntax that aid in fast-paced development projects [3] .

## CSS

CSS is essential for styling applications, enabling developers to control layout and presentation effectively. Advancements such as Flexbox and Grid provide powerful layout options, supporting responsive design. Industry sources highlight CSS's critical role in user interface development and its widespread application in modern web design **【4】** .

## Docker

Docker provides OS-level virtualization to package software into containers, ensuring consistency across environments. Its use promotes efficiency in managing development, testing, and production setups. Docker is recommended for its role in facilitating DevOps practices, notably in reducing discrepancies between environments **【5】** .

## Design and Methodology

### Design

The project was designed to have a robust backend using Express.js to handle API requests and serve data from a MySQL database. The frontend was developed using Pug for templating and CSS for styling, ensuring a responsive design. All of the [Project Diagrams](#) are available via our GitHub repository.

### Methodology

Our web application development was managed using Agile methodologies, with Scrum practices to ensure flexibility and responsiveness to change. The project was divided into four sprints, allowing the team to iteratively develop features and refine the application based on user feedback and technical requirements.

### Sprint Planning

Each sprint began with a planning meeting where the team prioritized backlog items, considering both the project requirements and feedback from the previous sprint. This process involved carefully assigning tasks to ensure an even workload distribution and optimal team productivity.

### Daily Stand-ups

Daily stand-ups were essential to our agile process. These brief meetings allowed team members to share their progress, discuss challenges, and coordinate activities efficiently. This practice was crucial for maintaining momentum and addressing any issues quickly, thereby avoiding delays in the project timeline.

### **Sprint Reviews and Retrospectives**

At the end of each sprint, sprint reviews were conducted with module tutor to demonstrate the functionality added during the sprint. These sessions were instrumental in gathering actionable feedback that was used to adjust the project trajectory and backlog priorities. Following the review, retrospectives provided a forum for the team to reflect on their workflow, collaboration, and individual contributions during the sprint, identifying areas for improvement.

### **User Personas and Feedback Integration**

A key component of our methodology was the regular update and refinement of user personas. After each sprint review, based on stakeholder feedback and observed user interactions, we updated the personas to better reflect the evolving understanding of our user base. These updates helped in realigning the development efforts with user needs and expectations, ensuring that the functionality developed was both relevant and beneficial to the end-user. The iterative updates to the personas were crucial for tailoring the application's design and features to the actual user requirements.

### **Agile Artifacts**

To keep the project organized and transparent, we utilized several Agile artifacts, including the Product Backlog, Sprint Backlog, and Increments. The Product Backlog was an evolving list of project requirements and enhancements, while the Sprint Backlog focused on the objectives of the current sprint. Increments consisted of all completed items from the sprint, contributing to a potentially releasable outcome at the end of each phase.

## **4.Implementation and Results**

The implementation involved setting up the project repository, configuring Docker for environment consistency, and developing the front and backend services. The application was tested extensively to ensure functionality and performance. The backend was structured to handle complex SQL queries efficiently, allowing for the dynamic generation of reports based on user inputs. The frontend was designed to be responsive and user-friendly, facilitating a seamless interaction experience across various devices and platforms.

Our Web app was designed to efficiently handle complex population data queries. It successfully implemented a wide range of reporting features that allow users to organize and retrieve data based on various demographic criteria. The implemented features include:

- **Country and City Reports:** Users can view reports of all countries and cities worldwide, sorted by population from largest to smallest. This also includes sorting within continents, regions, districts, and countries.
- **Top N Populated Reports:** The application allows users to specify 'N' to view the top N populated countries or cities in the world, a continent, a region, a country, or a district.
- **Capital City Reports:** Reports for all capital cities can be viewed, organized by population size from the largest to the smallest. This includes global, continental, and regional capital city data.
- **Population Details:** Detailed reports provide the population of people living in cities and those not living in cities across continents, regions, and countries. This includes the total population and percentages to give a clear demographic breakdown.
- **Language Statistics:** The application provides statistics on the number of people who speak major languages such as Chinese, English, Hindi, Spanish, and Arabic, including the percentage of the world population for each language.

#### **Additional Functionality:**

- **Data Management:** The application supports adding new datasets to the database, ensuring the system remains up-to-date and scalable.
- **Security Features:** Enhanced security measures were implemented, including user authentication with username and password requirements to ensure data integrity and privacy.

## **5.Conclusion**

### **Reflection**

As a team of five, we approached the OrionEngine-Ensemble project with enthusiasm and a readiness to tackle the challenges of developing a complex web application. Throughout this project, we gained invaluable hands-on experience with Agile methodologies, enhancing our skills in teamwork, project management, and adaptive planning. The iterative nature of the sprints allowed us to reflect continuously on our progress and refine our approach, which was crucial for our learning and development. We encountered several technical challenges, particularly in managing database interactions and ensuring responsive front-end design. Overcoming these obstacles through research, collaboration, and testing has significantly boosted our confidence and competence in software development.



## Future Work

Looking ahead, several enhancements can be made to the OrionEngine-Ensemble application to further increase its value and usability:

- **Enhanced Security Measures:** Implementing more robust user authentication mechanisms, such as two-factor authentication and biometric verification, to ensure enhanced security and data integrity. This will be crucial as the application scales and handles more sensitive demographic data.
- **Database Expansion:** Adding more demographic and economic indicators to the database to provide a broader range of data for analysis.
- **Advanced Data Analytics:** Integrating advanced data analytics features, which could include predictive modeling and machine learning algorithms to forecast demographic trends and provide more insightful reports.
- **User Interface Improvements:** Continuing to improve the user interface to make it even more intuitive and user-friendly, potentially incorporating more interactive data visualization tools.

## 6. References

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## 7. Appendices

<https://github.com/SazamAmmy/Software-Engineering-Sprints--OrionEngine-Ensemble.git>