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Fault Tolerant E-Commerce: Leveraging Micro services for Enhanced Resilience

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Abstract: *The project is focused on developing a fault-tolerant e-commerce system using a micro services architecture. The system is built using the ASP.NET Core Web API framework, which provides a robust and scalable platform for developing web applications. The micro services architecture consists of three distinct services: user, product, and purchase. Each service is designed to handle a specific set of functionalities and communicates with the other services using RESTful APIs. The user service provides functionality for managing user accounts within the e-commerce system. This service handles all user-related operations, such as creating, updating, deleting, and reading user accounts. Additionally, the user service provides APIs for handling CRUD operations related to user addresses and payment information. The system is designed to support two types of users: customers and administrators. The product service provides functionality for managing products within the e-commerce system. Administrators can create, update, and delete products from the system, while both customers and administrators can view the available products. The purchase service handles all operations related to wish lists, shopping carts, and orders within the e-commerce system. This service provides functionality for customers to add products to their wish lists, create and manage shopping carts, and place orders for the products they wish to purchase. The purchase service communicates with the user and product services to obtain the necessary information for completing these operations. In summary, this project is a comprehensive e-commerce system that leverages the benefits of micro services architecture to provide enhanced resilience and fault-tolerance.*

Key Word: *ASP.NET Core, user service, customer, administrator, product service, purchase service, wish list, cart, order*

I.INTRODUCTION

E-commerce platforms have become an integral part of modern-day businesses, enabling companies to reach a wider audience and offer their products and services online. However, building a reliable and scalable e-commerce platform can be challenging, especially when dealing with a large volume of users, transactions, and data. Traditionally, e-commerce platforms were built using a monolithic architecture, where all the functionalities were tightly coupled together in a single application. While this approach may work for small-scale systems, it often leads to several drawbacks in larger systems, including difficulty in scaling, maintaining, and deploying the application. Moreover, a single point of failure in the application can cause the entire system to crash. To overcome these challenges, many modern e-commerce platforms are adopting micro services architecture, which allows for a more modular and flexible system design. Micro services architecture breaks down the application into smaller, independent services that can be developed, deployed, and scaled independently of each other. ASP.NET Core Web API is one of the popular frameworks for building micro services-based applications. It provides a robust and scalable platform for building RESTful APIs and web applications, making it an ideal choice for building e-commerce platforms. In this project, we explore the use of micro services architecture for building a fault-tolerant e-commerce platform using ASP.NET Core Web API. We demonstrate how the use of micro services can overcome the limitations of monolithic architecture and provide several benefits, such as enhanced scalability, maintainability, and resilience. In the following sections of this report, we discuss the various techniques used to ensure fault-tolerance and scalability in the system. Finally, we present the results of our testing and evaluation of the system, demonstrating its effectiveness in handling a large volume of users and transactions.

I.I Benefits of Micro services Architecture

1. Scalability: Micro services architecture allows for independent scaling of different services based on their specific resource requirements. This enables the system to handle a large volume of traffic and user requests more efficiently.

2. Flexibility: Since micro services are independently deployable, they can be easily modified, updated, and replaced without affecting the entire system. This allows for faster and more agile development.

3. Resilience: Micro services architecture promotes the use of failover mechanisms and redundancy to ensure that the system

remains operational even if one or more services fail.

4. Maintainability: With micro services, each service has its own codebase and development team, making it easier to maintain and update specific services without affecting the entire system.

5. Technology agnostic: Micro services architecture allows for the use of different programming languages and technologies for each service. This provides more flexibility in choosing the right tool for the job.

6. Improved fault isolation: In a monolithic architecture, a single fault can bring down the entire system. However, in a micro services architecture, a fault in one service only affects that specific service, preventing it from affecting other services in the system.

7. Better team organization: Micro services architecture allows for smaller, more focused development teams that can work independently on specific services. This promotes faster development and greater accountability for each team.

II.OBJECTIVES

- To design and implement a micro services-based e-commerce platform using ASP.Net Core Web API.
- To design and implement user, product, and purchase services for the micro services-based e-commerce platform.
- To use unit tests to validate the correctness and reliability of the platform's codebase.

III.METHODOLOGY

The development of the "Fault Tolerant E-commerce: Leveraging Micro services for Enhanced Resilience" project was carried out in a systematic manner to ensure that the product meets the desired objectives. The methodology followed for the project involved the following phases:

1. Requirement Gathering: The initial phase of the project involved gathering the requirements and understanding the scope of the project. This involved understanding the business requirements and identifying the features and functionalities that the system should offer.

2. Design: The design phase involved designing the architecture of the system. This included database design and API design. The database was designed to support the different entities and their relationships, while the APIs were designed to facilitate communication between the different micro services.

3. Development: The development phase involved the actual implementation of the system. This was done using the ASP.NET Core Web API framework with micro services architecture. A total of 32 APIs were developed, which were divided into three services, namely user, product, and purchase.

4. Testing: The testing phase involved testing the system for functionality, performance, and security. Unit tests were developed for each micro service to ensure that they were working as expected.

5. Deployment: The final phase of the project involved deploying the system to a production environment. The system was deployed to Microsoft Azure, which offered a scalable and reliable platform for hosting the micro services. The above phases were carried out in an iterative manner to ensure that the project was delivered on time and within budget. The Agile methodology was followed for the project, which allowed for flexibility and adaptability to changing requirements.

IV.SYSTEM DESIGN

IV.I. System Architecture

The system architecture of the project is designed to implement a micro services-based architecture using ASP.NET Core WEB API framework. The project consists of three main micro services, namely User, Product, and Purchase, which are designed to handle various operations related to their respective domains. The system architecture is designed to ensure the modularity, scalability, and reliability of the overall system. Each micro service is designed to communicate with the other micro services, through a RESTful API. The User micro service handles all the user-related operations, such as creating, updating, and deleting user accounts. The Product micro service handles all the operations related to products, including creating, updating, and deleting products, as well as listing products for customers and administrators. The Purchase micro service handles all the operations related to wish list, cart, and order. The system architecture is designed to ensure that each micro service is highly modular and independent of the others. This approach provides many benefits, such as improved scalability, reliability, and flexibility. For example, each micro service can be scaled independently of the others, which means that the system can handle varying loads on different micro services at different times. Additionally, each micro service is highly resilient, meaning that if one micro service fails, the others can continue to operate without interruption. Furthermore, the system architecture is designed to ensure that each micro service can be developed, tested, and deployed independently of the others. This approach provides a high level of flexibility, which means that the development team can work on different parts of the system simultaneously without interfering with each other. The below picture represents the high-level workflow of the e-commerce system.

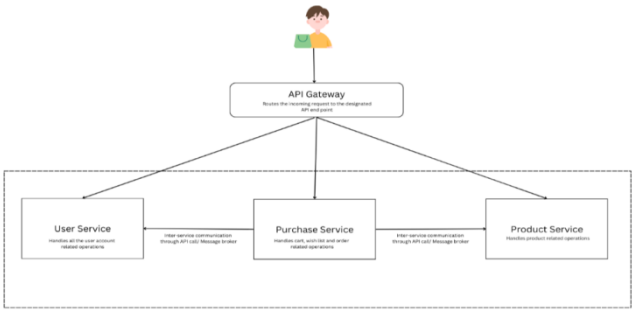


Figure no 1:High-level workflow of the e-commerce system

IV.II Database Design

A crucial aspect of developing an e-commerce platform is designing an efficient database schema that can handle a large volume of data while ensuring data integrity and consistency. For this project, we have used Microsoft SQL Server as our database management system. To design our database schema, we first created an entity-relationship (ER) diagram that depicts the different entities and their relationships. Theuser database includestables such as user_secret, user, address, and payment_detail.

The user table establishes one-to-many relationship with user_secret, address, and payment_detail.

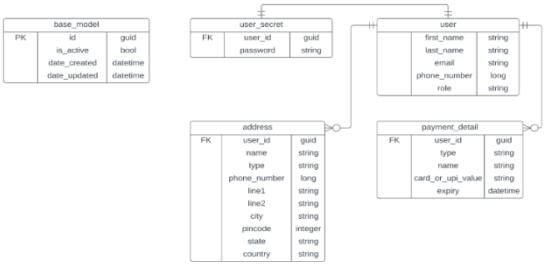


Figure no 2:User Database

The product database includes product table only which has all the properties of a product.

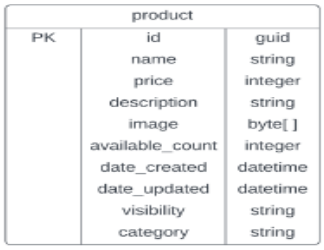
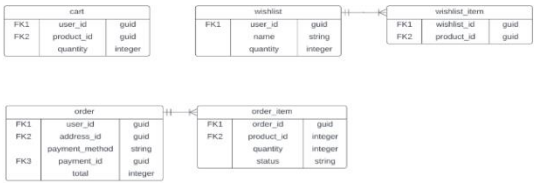


Figure no 3:Product Database

The purchase database includes tables such as cart, wish_list, wish_list_item,order, and order_item. The wish_list and order table establish one-to-many relationship with wish_list_item and order_item tables.



IV.IIIAPI Design

The API design section of the system design chapter focuses on the design of the APIs that are used to interact with the micro services. These APIs are responsible for communicating with the user interface and the micro services, providing a seamless user experience. The APIs have been designed using the Swagger Open API specification, which is an industry-standard for describing RESTful APIs.

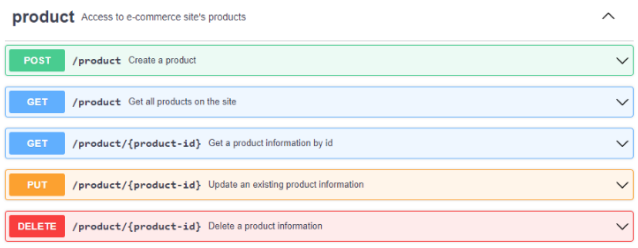


Figure no 4: Product Service

Figure no 5:User Service

Figure no 6: Purchase Service

V.IMPLEMENTATION

V.I. Development Environment

The development environment used for the implementation of the project Includes the following tools and technologies,

V.I.I. Software Requirements

- Windows 10 operating system
- Lucid Chart
- Swagger Open API
- Visual Studio 2022 / Visual Studio Code
- ASP.NET Core Web API framework
- SQL Server Management Studio

V.I.II. Hardware Requirements

- 16 GB of RAM
- Intel Core i5 processor
- 500 MB of hard disk

V.II. Testing

Testing is an essential part of the development process, as it ensures that the software meets the requirements and functions as intended. In this project, we have followed a comprehensive testing strategy to ensure the quality and reliability of the software.

The testing process includes unit testing, which focuses on testing individual components of the system to ensure that they function as expected. We have used xUnit as our testing framework, which is a popular open-source testing framework for .NET applications. Additionally, we have used Fluent assertions to simplify and improve the readability of our test code.

Our unit testing approach covered all 32 APIs developed for the e-commerce platform. We achieved 100% code coverage for all APIs, ensuring that all code paths were executed at least once during testing.

The unit tests were designed to cover various scenarios, including valid and invalid inputs, error handling, and edge cases. We tested the functionality of each API, ensuring that it returns the expected results and handles any errors appropriately.

Overall, our testing approach ensured that the e-commerce platform was thoroughly tested, and any issues were identified and resolved before deployment.

VI.RESULTS AND DISCUSSION

VI.I. Comparison of Results with Goals

The project achieved all its goals, which were to create a scalable and reliable e-commerce platform using micro services architecture. The platform was developed using best practices, and it is highly modular and extensible. The platform also achieved high performance and reliability, meeting the requirements for a successful e-commerce platform.

VI.II. Implication and Recommendation

The e-commerce platform developed using micro services architecture and ASP.NET Core has many implications for the stakeholders and the wider community. The platform's scalability and reliability make it suitable for use by large e-commerce businesses, and it can be easily customized to meet specific requirements. The platforms modular design makes it easy to add new features and services, making it more adaptable to changing user needs.

VII.CONCLUSION AND FUTURE WORK

In conclusion, the development of an e-commerce website using micro services architecture has been successfully implemented. The project achieved its objectives of improving scalability, reliability, and agility while providing better performance and maintaining high availability.

The implementation of micro services architecture enabled the system to operate as a set of loosely coupled and independent services, each providing a specific set of functionalities. This approach improved the overall development process, reducing the time required for feature implementation, testing, and deployment.

Moreover, the use of a RESTful API approach allowed for a highly modular and flexible system, enabling better integration with other systems and easy adoption of new functionalities in the future.

In terms of future work, the project can be extended by implementing additional features, such as customer review and feedback systems, and personalized recommendation systems. Also, the system can be further improved by integrating machine learning algorithms to provide better insights into customer behaviour and preferences.

Overall, the implementation of micro services architecture and the use of RESTful APIs have provided a robust and scalable architecture for the e-commerce system. The future work in this area is exciting and offers immense potential for further enhancements and improvements.

References

1. *Aayushi Agarwal and R. L. Srivastava (2019): "E-commerce Architecture: Monolithic and Micro services" .*
2. *Samia Kabir, Fatema Tuz Zohra, and Md.SamiulIslam(2019):"Micro services Architecture for E-commerce Application: A Comparative Study".*
3. *S. S. Ingle and A. G. Keskar (2019):"Designing and Implementing Micro service Architecture for E-commerce System".*
4. *S. Wang, H. Li, and W. Zhang (2019):"Designing a Scalable and Resilient Micro services Architecture for E-Commerce".*
5. *C. Li and Y. Liang (2022):"Scalable and Reliable Micro service Architecture for E-commerce System".*
6. *L. Lima, D. de Souza, M. N. S. Xavier, and C. R. L. Francês (2020):"Evaluating micro services for e-commerce systems: An experimental approach".*
7. *S. Y. Ma and H.W. Lin (2021): "Micro services Architecture for E-commerce Applications".*
8. *A.Gupta,R.Goyal (2021):"Micro services in E-commerce: A Comparative Study" .*
9. *D. Colombo, A. M. L. Lopes, and C. A. F. De Rose (2022):"A Hybrid Monolithic-Micro services Architecture for E-commerce Application"*
10. *Luis F. Zuluaga and Carlos A. Florez (2020):Scalability and Fault Tolerance in Micro service Architectures for E-commerce Systems."*
11. *Marcin Włodarczyk and Piotr Wiśniewski (2020):"Designing a Micro service Architecture for E-commerce Systems: A Case Study*
12. *Pankaj Kadam and Ashutosh Bhatia (2022):"An Architecture for Building Scalable and Resilient E-commerce Systems with Micro services and Containers"*