Development of a digital wallet using object-oriented programming and software design patterns

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***Abstract*— Electronic commerce refers to any commercial transaction that uses the transfer of information over electronic networks to buy and sell goods or services.[2] In this way, the purpose of this research is to show how a digital wallet can be developed using the concepts of object-oriented programming, as well as software design patterns. In order to achieve this objective, the application design process was developed, in which the user stories necessary to meet the needs of the application were determined. Likewise, class, activity, sequence, and deployment diagrams were created in order to guide the implementation of the software.**

Now, for the implementation of the software, Python version 3.12.1 and Java version 17.02.12 will be used for the development of the logical part of the software, in the same way for the development of the data layer, it was decided to use the SQL Alchemy library in order to perform the necessary operations in the database with a system similar to that of the programming languages used. The GraphQL tool will be used to easily manage services developed in the Python and Java backends. It is also important to note that the front-end of the application will be through a command line interface.

Docker software will be used to automate the deployment of the application as a local host.

I. INTRODUCTION

Object-oriented programming is defined as a programming paradigm that attempts to simulate things in the real world through elements called objects. These objects have some characteristics such as inheritance, polymorphism, encapsulation, and abstraction. [3]

Abstraction is defined as a process where the essential characteristics of an object are extracted depending on their importance in solving the problem. On the other hand, encapsulation is the process of hiding information from the end user, establishing visible details that contribute to the user experience, and hidden details that support the software. Modularity aims to reduce a system into parts, in this way it is sought that the parts of the system have high connectivity (cohesion) and reduced association (coupling). Inheritance is a mechanism with which new classes are created that reuse and modify the behavior of previously created classes. Inheritance is defined hierarchically where a parent class is defined over several child classes. Polymorphism is defined as the ability of objects belonging to a class to generate a different response depending on the parameters sent to it. [3]

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Likewise, these objects are defined as a series of behaviors called methods and properties known as attributes. [1].
Within the object-oriented programming paradigm, the SOLID principles are presented, aimed at improving the understandability and maintainability of software. [5]. The SOLID principles are discussed below: The single responsibility principle (S) determines that the software module must have a single reason for changing. Now, the principle of open and closed (O) states that the modules must be open for extension and closed for modification. The Liskov substitution principle (L) states that the classes of a program can be replaced by the instances of their subclasses, without altering the functionality of the program. The principle of interface segregation (I) states that if we create an interface we must ensure that the class that is going to implement this interface will have the ability to implement all the methods. Dependency inversion (D) means that parent and child modules should not depend on implementations, but on abstractions.
According to the authors [7], design patterns are proven solutions to certain problems encountered when designing software.
This project search to develop an digital wallet using the object-oriented programming paradigm and the software patterns. The author [4] defines digital wallets as software that allows us to store electronic money for later use in online commerce. Likewise, the author states that digital wallets are used as a means of payment to send and receive money safely.

Starting from these concepts, it is important to highlight that this research aims to understand how object-oriented programming can be used to develop software for an virtual wallet platform. In the same way, this project will be developed with a monolithic architecture, which is defined as an architecture in which all the layers of the application are compiled into a single unit. [6] So, in this document, the second chapter will discuss the methods and materials necessary to develop object-oriented software from the virtual wallet. In the next chapter, the experiments to be carried out to meet the objective of developing a virtual wallet will be discussed and the results of this experimental practice will also be discussed. In a final chapter, the conclusions about the functionality of object-oriented programming and the software design patterns in the creation of a virtual wallet

will be developed.

II. METHODS AND MATERIALS

A. Methods

This project aims to develop a functional virtual wallet platform. To do this, the following technical decisions will be made.

For the implementation of the software, Python version 3.12.1 and Java version 17.02.12 will be used for the development of the logical part of the software, in the same way for the development of the data layer, it was decided to use the SQL Alchemy library in order to perform the necessary operations in the database with a system similar to that of the programming languages used.

It is also important to note that the front-end of the application will be through a command line interface.

In the same way, the decision was made to use the GraphQL tool to manage and unify the services of the Python and Java back-ends.

On the other hand, the development of the automated deployment is intended to use the Docker software.

Regarding the development process, we decided to use the GitHub storage software to facilitate the cooperative development of the application and the management of its versions.

Class diagram decisions:

When we developed the class diagram, the following decisions were made:

It was decided to create a user class that contains the attributes of type id, user ID, password, phone and permissions. Likewise, this class will have the methods create account and log in. This class will function as an interface for the customer class and the Admin class.

The customer class was created in order to specialize each customer according to the permissions they have, in this way the user will have a higher level when registering certain data in the application. This class will have the attributes name, wallet ID, email, personal image and current address, it will also have a method to add their home address.

The admin class was developed in order to have more complex permissions, such as the ability to freeze digital wallets.

The wallet class contains the attributes necessary to represent a digital wallet. It will have the wallet id, wallet owner ID, wallet balance and the movements that have been made in it. It will also have the necessary methods to withdraw, send, add and request funds and it will also have a method to show the movements of the wallet and add a credit card to the wallet.

The transaction class has the attributes account reference id, wallet ID, transaction amount, date and recipient. It will also have a method to send the transaction to the wallet movements.

The address class was developed in order to group the attributes street, apartment, city, country and zip code.

Finally, the credit card will contain the attributes necessary to represent a credit card such as the number, expiration date, cvv and name, as well as a wallet ID attribute to link it to a specific digital wallet. The complete class diagram is attached at the end of the document (Fig 1. Class diagram).

B. Materials

In the project, some hardware elements will be used for the development of the online sales platform, among them 1 GB of ram will be used for the execution of the software since we consider it necessary for the efficient performance of the application. A 10th generation Intel core i5 processor will also be used because this processor can run the processes to meet the demand of the platform. Finally, a 1 GB storage space intended only for the execution of the application will be used, because we consider that this can store the software information and other software necessary for development, without generating problems with the space reserved for the operating system.

III. RESULTS

To verify the correct functioning of the software, it was decided to use user stories as a way of verifying the effectiveness of the software. In this way, it will be determined whether each of these stories can be fulfilled with the digital wallet at the end of the project.

Unit tests of the code will also be carried out to determine whether the software meets its intended purpose. To do this, the persistence of the information will be tested by checking whether the information can be stored and manipulated correctly in the database. On the other hand, tests of the application services will be carried out in order to determine whether they generate the information requested in each case.

IV. CONCLUSIONS

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V. ANNEXES

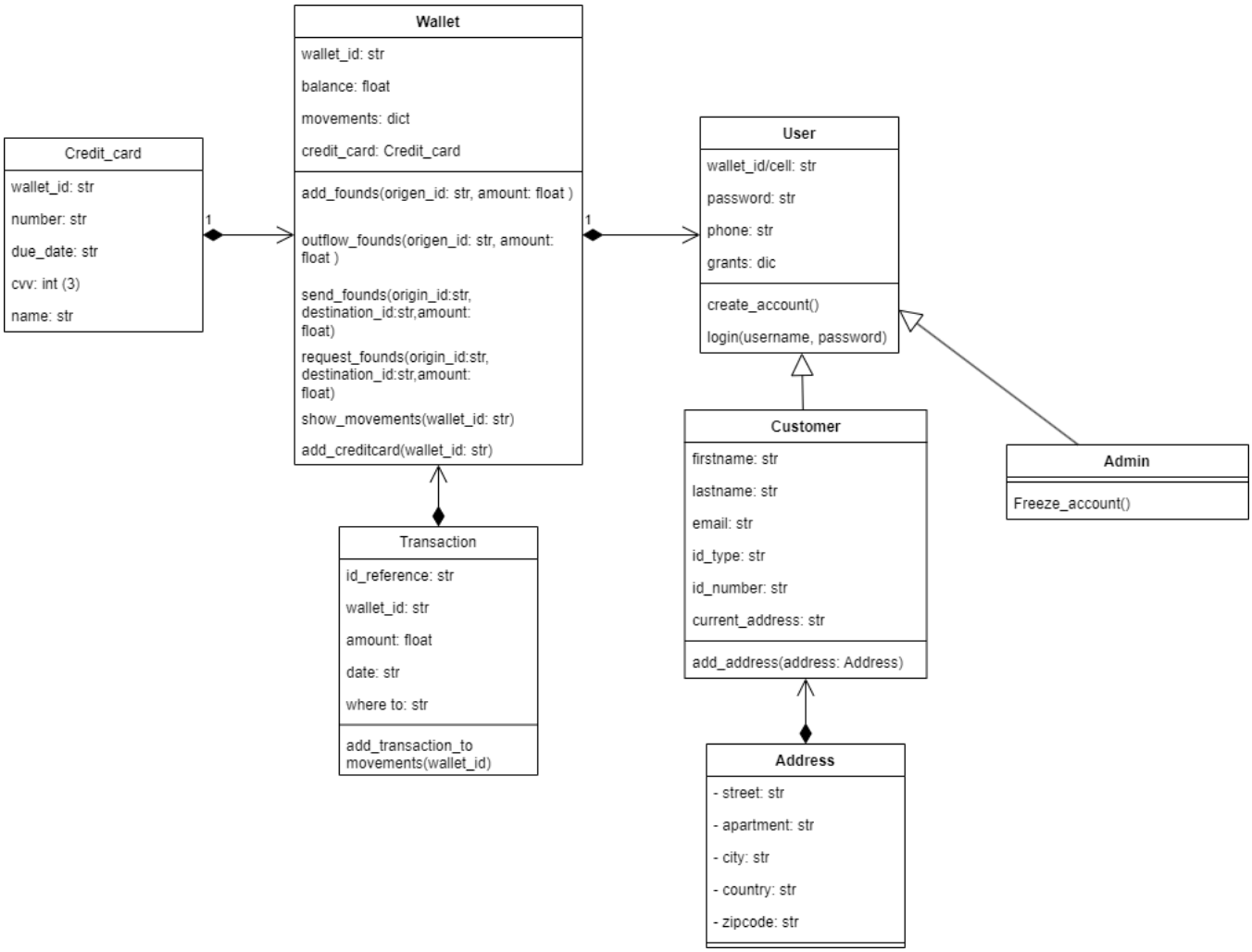

Fig. 1. Class diagram