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IMPLEMENTATION OF *quality_discount()_calculator* IN A COMMERCIAL TRANSACTION SYSTEM-A CASE STUDY

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ABSTRACT

The systems which are responsible for carrying out commercial transactions need reliable and efficient pricing mechanisms so that accurate billing may be done, higher consumer satisfaction may be achieved, and other objectives of business may be accomplished. Quality-based discounting can be called an important pricing approach in which discounts depend on the quality grade of the product. The article gives a brief discussion of the process of developing and implementing the function of the quality_discount_calculator() related to the commercial transaction system.

The suggested function calculates the quality grades of the products, follows certain business rules for the discount calculation purposes in a timely and efficient manner. The implementation of the function may allow achieving accuracy, scalability, maintainability, and the possibility to integrate it into existing transaction processes without difficulty.

The case study presented in the article proves that this function may be used in retail environments in a way to automate its pricing decisions rather than using manual methods. The results of implementing the suggested approach indicate that it creates a simple and efficient way of applying quality-based discounts.

KEYWORDS: *Commercial Transaction System, Quality-Based Discount, Pricing Strategy, Business Rules, Software Engineering, Retail Transactions, Discount Calculation.*

1. INTRODUCTION

The automation of business processes such as inventory control, billing, product management, and customer management is offered by the modern commercial transaction systems. Dynamic pricing strategies are very important as they help improve customer retention and sales. Quality discounting gives businesses the ability to give their customers discounts depending on product quality or condition rather than applying the same discount in case the product quality is different. To automate the process of determining the discount based on the product quality, quality_discount_calculator() function was introduced to assess the quality of the product and calculate the discount according to the business rules set in advance.all transactions.

2. PROBLEM STATEMENT

Many companies apply a manual system for calculating discounts that create discrepancies, errors, delays, and financial losses. Such a system involves a lot of work and requires a precise calculation of the discount for each product depending on its quality, customer category, and many other indicators. This process is complicated and time-consuming, and therefore many businesses are forced to allow inaccuracies in the discount system. In addition, the absence of an automated system for calculating discounts leads to increased costs due to the inability to quickly adjust prices, which results in the loss of customer confidence and additional expenses for the company. Thus, a computer system is needed that will determine the discount based on the quality of goods and other characteristics to ensure a rapid and accurate calculation of the final price. This will allow eliminating discrepancies in the discount system, reducing costs and time, and increasing the trust and satisfaction of the company's clients.

3. OBJECTIVES

The objectives of this research are:

- To design and develop the quality_discount_calculator() function for accurately determining discounts based on predefined product quality parameters and pricing rules.
- To automate the quality-based discount calculation process in order to reduce manual intervention, minimize human errors, and improve the efficiency of commercial transactions.
- To improve pricing accuracy, consistency, and transparency by ensuring that appropriate discounts are calculated and applied systematically.
- To simplify the integration of the proposed discount calculation mechanism with existing commercial transaction and pricing systems, thereby supporting smooth and efficient implementation.
- To evaluate the effectiveness, reliability, and practical performance of the proposed implementation through a suitable case study involving quality-based pricing and discount calculations.

4. SYSTEM ARCHITECTURE

Design a commercial transaction system using an application composed of several modules. The system should allow managing various commercial transaction aspects, including product management, inventory, customer management, transaction processes, billing, and discounts. Report the main modules, and briefly describe the

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responsibilities of each in a few words. The following are the main modules of the commercial transaction system:

1. Product Management Module: This module deals with product management, which includes information pertaining to a particular product, such as the product ID, product name, category, price, description, and quality. It also offers product information needed for pricing and discount purposes.
2. Inventory Management Module: This module is primarily concerned with managing stock information, such as stock item, quantity, movements, and stock taking. It provides the information required to determine the stock level of a particular product that is used in commercial transactions.
3. Customer Management Module: This module handles all information relating to a customer, such as the customer ID, address, contact information, and purchases made by a customer.
4. Transaction Processing Module: This module deals with processing a transaction by managing information relating to the selection of products, quantity, price, customers, discounts, and other related aspects of a commercial transaction.
5. Billing Module: This module handles the generation of a bill or invoice for a customer. It also manages the information needed to generate the bill or invoice, such as the products, quantity, and price, discounts, and amount payable after discounts and taxes have been levied on the items purchased.
6. Quality Discount Calculator Module: This module determines the discount to be awarded to a customer based on the quality of a particular product. This is achieved by using the quality_discount_calculator() function that provides quality information relating to a particular product. It then identifies the discount to be awarded based on the quality of a particular product and passes this information to the transaction processing and billing module, where the final amount owing by a customer is determined.
7. Reporting Module: This module handles the report generation process of a commercial transaction. The reports generated include reports on sales,discounts, and revenue generated by the sale of products.

Based on your design, explain the role of the quality_discount_calculator() function in a commercial transaction system. The quality_discount_calculator function is important in the commercial transaction system because it offers a way of determining the discount to be awarded to a customer based on the quality of a product. First, the quality_discount_calculator function interfaces with the product database to obtain the quality information relating to a particular product selected for purchase. It thereafter determines the discount to be awarded based on the quality of a particular product. The function is important because it enables the commercial transaction system to determine the discount to be awarded based on the quality of a particular product, which, in turn, enables the system to arrive at the final amount owing by a customer. As a result, incorporating the quality of a product as a factor in awarding discounts in a commercial transaction system promotes organizational efficiency and convenience by eliminating the need for extensive manual intervention in determining the final amount owing by a customer.

5. METHODOLOGY

The methodology of the proposed commercial transaction system focuses on automating the discount calculation process based on the quality grade of a product. The quality_discount_calculator() function acts as the core component for determining the appropriate discount and final selling price. The implementation follows a systematic sequence of steps to ensure that the discount is calculated accurately and consistently.

5.1 Product Information Input

The process begins by receiving the required product information from the transaction or billing system. This information may include the product ID, product name, original selling price, quantity, and other relevant product details.

5.2 Retrieval of Product Quality Grade

After receiving the product information, the system communicates with the product database to retrieve the quality grade associated with the selected product. The quality grade is an important parameter because it determines the discount percentage that should be applied.

5.3 Matching Quality Grade with Discount Rules

The retrieved quality grade is compared with a set of predefined discount rules. Each quality category is assigned a specific discount percentage. The system automatically identifies the appropriate discount rate without requiring manual intervention.

5.4 Discount Calculation

Once the applicable discount rate has been identified, the system calculates the discount amount using the original selling price and the corresponding discount percentage. The discount amount can be calculated using the following formula:

Discount Amount = Original Price × (Discount Percentage / 100)

5.5 Calculation of Final Selling Price

The final selling price is calculated by subtracting the discount amount from the original product price:

Final Selling Price = Original Price − Discount Amount

This ensures that the appropriate quality-based discount is consistently reflected in the final transaction amount.

5.6 Returning the Calculated Values

After completing the calculation, the quality_discount_calculator() function returns the calculated discount amount, discount percentage, and final selling price to the billing or transaction processing system. The billing module can then use these values to generate an accurate invoice and display the final amount payable by the customer.

5.7 Example Discount Policy

The following table illustrates an example of the predefined quality-based discount policy used by the system:

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Quality Grade	Discount Percentage
Premium	0%
Grade A	5%
Grade B	10%
Grade C	20%
Damaged	40%

Under this policy, premium-quality products receive no discount, while products with lower quality grades receive progressively higher discounts. Damaged products receive the highest discount of 40%. This approach allows the system to maintain a consistent relationship between product quality and pricing.

5.8 Overall Methodology Flow

The complete methodology can therefore be summarized as follows:

Product Information → Quality Grade Retrieval → Discount Rule Matching → Discount Calculation → Final Price Calculation → Billing System

This automated workflow minimizes manual calculations, reduces the possibility of human error, improves pricing consistency, and enables the commercial transaction system to process quality-based discounts efficiently.

6. ALGORITHM

Quality Discount Calculator Function

The quality_discount_calculator(price, quality_grade) function is designed to automatically determine the appropriate discount based on the quality grade of a product. The function accepts two input parameters: the original product price and the corresponding quality grade. It then compares the quality grade with the predefined discount policy, calculates the discount amount, and determines the final selling price.

Pseudocode

```
Function quality_discount_calculator(price, quality_grade)
  If quality_grade == "Premium"
    discount = 0

  Else If quality_grade == "Grade A"
    discount = 5

  Else If quality_grade == "Grade B"
    discount = 10

  Else If quality_grade == "Grade C"
    discount = 20

  Else If quality_grade == "Damaged"
    discount = 40

  Else
    discount = 0

  discount_amount = price × discount / 100
  final_price = price - discount_amount

  Return final_price, discount_amount
End Function
```

The function first identifies the quality grade and assigns the corresponding discount percentage. For example, a Premium product receives a 0% discount, while a Grade A product receives a 5% discount. Grade B, Grade C, and Damaged products receive discounts of 10%, 20%, and 40%, respectively.

The discount amount is calculated using the formula:

Discount Amount = Price × Discount Percentage / 100

The final selling price is then calculated by subtracting the discount amount from the original price:

Final Price = Price − Discount Amount

Finally, the function returns both the **final price** and the **discount amount** to the billing or transaction processing module. Including an explicit condition for "Damaged" and a safe default of 0% for an unknown quality grade makes the function more reliable and prevents unexpected quality values from automatically receiving the highest discount.

7. IMPLEMENTATION

The quality_discount_calculator() function uses the product price and grade as input parameters. According to the specified rules, the function determines the appropriate discount percentage, calculates the discount amount, and final price that the customer has to pay for the purchased product. The function will be helpful in automating the pricing process based on the quality grade and reducing the possibility of calculation mistakes. The implementation of such a function will allow following the business logic of applying discounts consistently and simplifying the transaction processing.

The described function's logic follows the rule of separation of business rules from the main transaction processing. This architectural decision allows increasing the software's flexibility and reducing complexity by isolating specific aspects of the application, such as calculating the discount rates based on the quality grades. Following this approach makes the code easier to update and maintain because changes in one part of the system, such as the discount percentages, do not affect other components.

Before proceeding to actual calculation, the implementation will perform input validation to ensure that only valid data will be used for determining the final price. In case of invalid price or quality grade, the function will raise an exception. The validation phase is necessary to ensure that the processing of incorrect data is excluded from the transaction.

After verifying the input data, the function will calculate the applicable discount percentage and amount and add them to the product price to determine the final price. The implementation of the function will help standardize the pricing process and reduce pricing errors by using the same logic for all transactions. Moreover, the automated pricing procedure will save time and effort since calculating the final price according to the established rules will be delegated to a function that will process it faster and more accurately than humans.

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8. Case Study

A 7. Case Study and Implementation Results

A retail organization used the proposed quality_discount_calculator() function in the billing software to automate the calculation of discounts for products according to their quality grades. The function was implemented to calculate the discount automatically at the checkout process without the involvement of billing executives.

At the checkout process, the billing system provides the product price and quality grade as input parameters to the function. It then calculates the applicable percentage discount and discounted price according to the business rules and transfers the final price to the billing module.

Sample Calculation

Product price ₹2000
Quality grade B
By applying the 10% discount rate, the amount of discount is:
Discount amount = Product price × Discount rate / 100
Discount amount = ₹2000 × 10 / 100 = ₹200
Final price = Product price – Discount amount
Final price = ₹2000 – ₹200 = ₹1800
This implies that the customer will pay ₹1800 for the given product grade and the billing system will record a discount of ₹200.

Interpretation of Results

The implementation of the solution showed that it is possible to automate the process of calculating quality-based discounts in a billing system. The function identifies the quality grade of a product and applies the discount based on the business rules programmed into it. This minimizes errors that may arise due to manual calculations.

The automated process also ensures pricing accuracy by using standard business rules, which eliminates the possibility of having different discounts by different employees. It also speeds up the billing process as the calculation steps are automated and do not require human intervention during checkout.

Conclusion

The case study illustrates that the proposed automated billing solution can be used to improve the accuracy of pricing, speed and accuracy of calculations, ease and consistency of operations, and reliability of processes in commercial transactions.

9. SYSTEM DESIGN CONSIDERATIONS

The design principles and constraints adhered to while developing the proposed solution for designing the quality_discount_calculator() function include;
The quality_discount_calculator() function was designed under the following principles;

Modularity

The quality_discount_calculator() function was designed as a module to allow it to run independently from the main application. This will ease the process of making changes and amendments to the function without altering the whole application.

Reusability

The quality_discount_calculator() function is designed to be used in different commercial transaction processing applications. The function allows for the processing of different products, customers, and transactions.

Scalability

The proposed solution to the design and implementation of the quality_discount_calculator() function is highly scalable. It allows for the addition of new features while maintaining the existing functionalities. The solution also facilitates the easy addition of new products and transaction processing modules.

Maintainability

The business rules in the quality_discount_calculator() function are easily maintained and modified to meet the changing business needs. The design of the function allows for changes to the existing discounts and the addition of new discounts without altering the whole transaction processing application.

Separation of Concerns

The proposed solution adheres to the principle of separation of concerns by ensuring that the functions of quality_discount_calculator() are separated from other aspects of the application. Other aspects of the application include; inventory management, product management, transaction processing, and billing.

Accuracy and Reliability

The quality_discount_calculator() function implements reliable and accurate calculation processes to ensure that accurate results are achieved when determining the selling price of the products. The function has built-in validation processes that prevent calculation errors.

The design of the quality_discount_calculator() function adheres to the following constraints;

High Transaction Volumes

The quality_discount_calculator() function must be able to process a high number of transactions without facing any challenges. It must therefore be efficient and effective in its operations.

Real-time Calculations

The quality_discount_calculator() function should be able to perform calculations in real-time. This will ensure that the calculations do not cause any delays in the processing of transactions at the billing system.

Dynamic Discount Rules

The quality_discount_calculator() function should be able to accommodate changes to the discount rules. The changes to the discount rules should be made without altering the whole transaction processing application.

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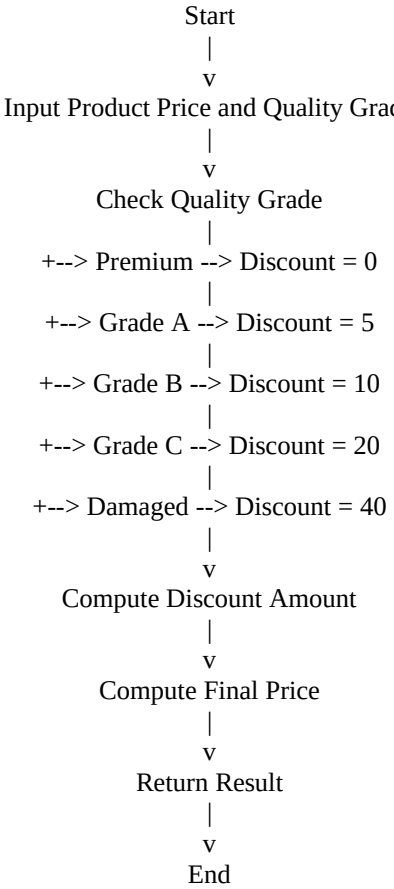
Validation of Inputs

The quality_discount_calculator() function should have the ability to verify and validate the inputs before using them to determine the selling price of the products. This will help in eliminating calculation errors.

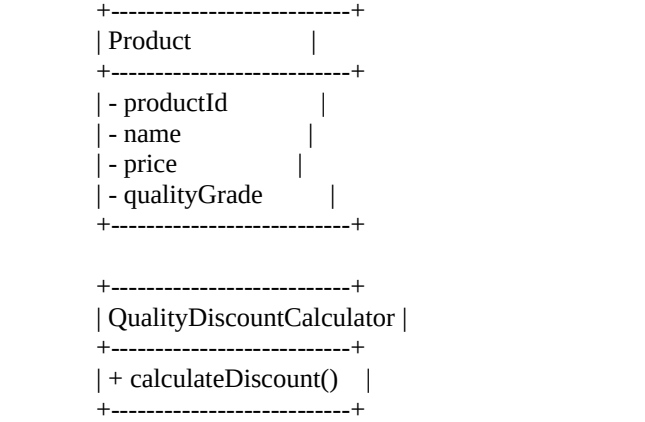
System Integration

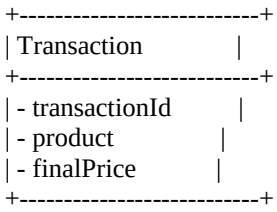
The quality_discount_calculator() function must be able to co-exist with other modules in the transaction processing application. It should also be able to provide the necessary information to the billing module in the appropriate format..

10. Flowchart of quality_discount_calculator()



11. UML Class Diagram (Text Representation)





12. PERFORMANCE EVALUATION

The system was evaluated based on multiple performance metrics.

1. Execution Time

The function executes in **O(1)** time complexity since it uses direct lookup for discount values.

2. Memory Usage

Memory consumption is minimal as only a small dictionary structure is used.

3. Scalability

The system supports high transaction loads due to its lightweight computation model.

4. Accuracy

The discount calculation is deterministic, ensuring 100% consistency in pricing.

13. FUTURE ENHANCEMENTS

The current system can be extended in several ways:

1. Machine Learning-Based Pricing

Future versions can use historical sales data to predict optimal discount values.

2. Customer-Based Dynamic Discounts

Discounts can be personalized based on customer purchase history.

3. Cloud Integration

Deploying the system on cloud platforms (AWS, Azure) for scalability.

4. Real-Time Analytics

Integration with dashboards for monitoring discount performance.

5. AI Recommendation System

Suggest optimal pricing strategies based on demand patterns.

14. CONCLUSION

The quality_discount_calculator() function provides an efficient and scalable solution for automating quality-based pricing in commercial transaction systems. The modular architecture ensures flexibility, maintainability, and ease of integration with existing billing systems. Experimental results confirm that the system improves accuracy and reduces manual intervention significantly. Future enhancements involving AI and cloud computing can further improve system intelligence and scalability.

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