



*Green University of Bangladesh*

*Department of Computer Science and Engineering (CSE)  
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## **Super Shop Database System**

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<b><u>Lab Project Status</u></b>	
<b>Marks:</b>	<b>Signature:</b>
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# Chapter 1

## Introduction

### 1.1 Overview

The Shoper Shop Management System is a database-driven solution designed to handle the fundamental operations of a retail business in a structured and automated way. The project integrates all major aspects of a small to medium-scale shop, including customer management, product categorization, supplier coordination, stock control, order processing, payment tracking, and delivery management.

The system is organized around nine core relational tables:

- Customers – maintains customer profiles with unique IDs, contact information, and addresses.
- Categories – classifies products into structured groups such as Grocery, Beverages, and Personal Care.
- Suppliers – records supplier details for effective supply chain management.
- Products – stores product data including price, available stock, category, and supplier linkage.
- Cart – holds items temporarily before an order is finalized.
- Orders – captures completed purchase transactions with aggregated totals and timestamps.
- OrderDetails – provides a breakdown of each order into individual items, quantities, and statuses.
- Payments – logs all customer payments with dates, amounts, and methods (Cash, Card, Mobile Banking).
- OrderDelivered – confirms and tracks delivery of orders.

To ensure data consistency and automation, several triggers have been implemented:

- Automatic calculation of cart totals before insertion.
- Automatic calculation of order totals before insertion.
- Transfer of items from cart to order details, stock updates, and cart clearance after order creation.
- Automatic update of order status to *Confirmed* after successful payment.
- Automatic update of order status to *Delivered* once delivery is recorded.
- Default assignment of the latest order ID to payments when not explicitly provided.

The system was tested using sample data for customers, categories, suppliers, and products. A wide range of 50 SQL operations (including inserts, updates, deletes, joins, reports, and aggregations) were executed to validate functionality. These operations demonstrated how the system can track customer activities, manage product inventories, generate order histories, analyze sales trends, and monitor supplier contributions.

## **1.2 Motivation**

In today's world, even small and medium-sized shops are expected to manage their operations in a systematic and efficient manner. Traditionally, shopkeepers rely on handwritten records to keep track of sales, customer details, and product stock. While this approach may work for very small businesses, it often leads to errors, mismanagement, and difficulties in monitoring payments, deliveries, or supplier information. The motivation behind developing the Shoper Shop Management System arises from the need to simplify and automate these routine tasks. By introducing a centralized database system, shop owners can save time, reduce manual errors, and maintain accurate records of their daily activities. The system ensures that stocks are updated automatically, orders are recorded properly, and payments are tracked without confusion, which in turn improves customer satisfaction and builds trust. Moreover, having a database-driven solution allows the generation of reports and insights that can help in decision-making, such as identifying top-selling products, monitoring supplier contributions, and understanding customer preferences. On a personal level, this project is also motivated by the desire to apply database design knowledge to a real-world context, proving that the concepts learned in theory can be transformed into a practical tool capable of genuinely supporting the needs of a shopkeeper.

## **1.3 Problem Definition**

### **1.3.1 Problem Statement**

Managing the operations of a shop is often challenging when it relies on manual record-keeping. Shopkeepers commonly use notebooks, spreadsheets, or memory-based methods to track sales, product stock, customer details, and supplier information. This approach is error-prone and inefficient, especially as the business grows. Problems such as inaccurate stock counts, misplaced customer orders, delayed updates on payments, and lack of proper delivery tracking frequently occur. Without an integrated system, it becomes difficult to monitor overall sales performance, identify top customers or products, and ensure that payments and deliveries are recorded correctly. These issues not only increase the workload for the shop owner but also create dissatisfaction for customers due to delays, mistakes, or poor service. Therefore, there is a clear need for a database-based management system that can automate critical processes, maintain data accuracy, and provide reliable insights for decision-making. The Shoper Shop Management System is designed to address these challenges by offering a structured, automated, and user-friendly solution.

### **1.3.2 Complex Engineering Problem**

The management of a shop may appear simple at first glance, but when examined closely, it involves multiple interconnected processes that make it a complex engineering problem. Customer information must be stored securely and linked with their orders, products need to be categorized and tracked for availability, suppliers must be associated with each item, and payments have to be recorded in a way that reflects the true financial state of the business. Additionally, stock levels must automatically decrease after an order, order details must remain consistent with payments, and deliveries must be tracked in real time. Handling these requirements manually not only increases the chance of errors but also creates difficulties in scalability when the shop grows. From a database engineering perspective, the challenge lies in designing a schema that ensures referential integrity, automation through triggers, and consistency across multiple transactions without data loss or duplication. The Shoper Shop Management System addresses this by transforming the shop's daily operational needs into a well-structured relational database model, supported by triggers and queries that solve real-world business complexities in an automated and reliable way.

## **1.4 Design Goals/Objectives**

The primary objective of the Shoper Shop Management System is to design a robust and scalable relational database that can effectively manage the essential business operations of a retail shop. These operations include inventory management, order processing, payment tracking, customer management, and delivery tracking. The system aims to automate key business processes, reduce human error, and streamline the flow of information between different departments or aspects of the shop's daily operations.

One of the fundamental design goals is to create a normalized relational database schema that eliminates data redundancy and ensures data consistency. By establishing relationships between tables (such as linking customers, orders, payments, and products), the system is designed to minimize duplicate data entries and maintain a consistent state across all tables. Foreign key constraints will ensure that only valid references are made between entities, such as ensuring an order cannot be placed without a valid customer, and a product cannot be sold without having an associated stock quantity. This focus on referential integrity is crucial to maintaining an accurate and reliable database.

In addition, the system will leverage database triggers to automate critical tasks such as calculating the total amount in the cart before an order is placed, automatically updating stock quantities when an order is confirmed, and setting the order status to Confirmed upon successful payment. These triggers will enable the system to function with minimal user intervention, thus enhancing operational efficiency and eliminating the risk of human error. For example, once a payment is recorded, the status of all associated order items will be updated automatically to reflect their confirmed status. Similarly, the database will update the stock quantity whenever products are purchased and orders are completed, ensuring that inventory levels are always accurate in real-time.

A major objective of this system is to enable advanced data reporting and analytics. The database will be capable of running various complex queries that provide valuable business insights such as:

- Sales trends (e.g., identifying the top-selling products or highest revenue-generating categories).
- Customer behavior analysis (e.g., identifying loyal customers or monitoring purchase patterns).
- Supplier performance tracking (e.g., evaluating suppliers based on product availability and

delivery time). These reports will help the shop owner make informed decisions about stock replenishment, promotional strategies, and customer engagement, contributing directly to the business's success and growth.

Another key goal is to ensure the system is scalable and adaptable to future needs. As the shop grows, the system should easily accommodate new customers, products, orders, and suppliers without compromising performance. For example, the database design will allow for adding new categories of products or payment methods without requiring significant restructuring of the database schema. This flexibility will allow the system to evolve with the business, ensuring long-term viability.

The system will also prioritize usability and accessibility, making it straightforward for users to interact with the system. The database interface should be user-friendly for non-technical users, with simplified forms for adding products, updating customer details, and processing orders. Despite the underlying complexity of the database, the front-end interface will be designed to present data in an intuitive and clear manner, minimizing the learning curve for shop employees.

Additionally, security and data privacy are critical components of the design. Sensitive customer data, such as personal details and payment methods, will be stored securely, with proper encryption and access controls in place to prevent unauthorized access. The database will comply with best practices for data protection, ensuring that sensitive information is handled responsibly.

In summary, the design goals of the Shoper Shop Management System focus on building a reliable, automated, and efficient database solution that simplifies shop management, reduces operational overhead, ensures data integrity, and provides valuable business insights. The system will support growth and adaptability, ensuring that it remains a powerful tool for shop owners and employees as their business scales. The overall objective is to create a seamless experience that improves operational efficiency and business decision-making through a well-structured and automated system.

## **1.5 Application**

The Shoper Shop Management System is designed to be a versatile and efficient tool for small to medium-sized retail businesses. Its application spans various key operational areas, enabling shop owners, employees, and administrators to automate tasks, track inventory, and ensure smooth business operations with minimal manual intervention. The system is particularly useful in environments where inventory management, customer service, and order tracking are critical to the business's success.

### **1.5.1 Retail Shop Management**

The system serves as a comprehensive solution for daily shop management. Shopkeepers can use it to:

- Manage product stock levels in real-time, reducing the risk of stockouts and overstocking.
- Track customer purchases through the cart and order management system, making it easier to follow up on customer orders and preferences.
- Process payments securely through multiple methods such as cash, card, and mobile banking, with automatic tracking of payment statuses.
- Monitor the delivery status of orders, ensuring timely fulfillment and customer satisfaction.

### **1.5.2 Inventory and Stock Control**

The inventory management aspect is crucial for any retail business. The system automatically updates stock levels as orders are processed, ensuring accurate and up-to-date information on product availability. Through the real-time stock tracking, shop owners can:

- Receive alerts for low stock levels and make timely restocking decisions.
- Easily manage product categories to keep track of items based on their type (e.g., Grocery, Beverages, Household).

- Track supplier performance, monitoring the supply chain to ensure timely deliveries and reduce supply disruptions.

#### 1.5.3 Sales and Order Tracking

The system is designed to streamline the order processing workflow. Customers can place orders that automatically convert into confirmed orders once payments are made. Each order's status is tracked from processing to delivery, providing clear visibility into the sales pipeline. This feature enhances efficiency by:

- Eliminating manual entry errors in order details.
- Automating the generation of invoices and receipts for customers.
- Providing reports on sales performance, helping the shop owner analyze which products or categories are performing best.

#### 1.5.4 Customer Relationship Management

The system's ability to store and track customer data allows shop owners to build stronger relationships with their clientele. Key applications include:

- Customer order history tracking, enabling the shopkeeper to recommend products based on previous purchases.
- Managing customer loyalty by identifying frequent buyers and offering tailored discounts or promotions.
- Storing customer preferences and contact details, ensuring personalized service for repeat customers.

#### 1.5.5 Reporting and Analytics

One of the most powerful aspects of the Shoper Shop Management System is its analytics and reporting capability. The system provides insightful reports that allow the shop owner to:

- Analyze sales data, such as identifying the most popular products, peak sales times, and customer purchasing patterns.
- Monitor supplier performance by comparing delivery times, stock availability, and quality of products supplied.
- Track financial health, with reports on total sales, payments, and expenses, making it easier to plan for business growth and manage cash flow.

#### 1.5.6 Future Scalability

The system is designed with scalability in mind, making it adaptable to the growing needs of a retail business. As the business expands, the system can easily accommodate:

- Additional products and categories.
- More customers and orders without a decline in performance.
- New features and integrations (e.g., integration with e-commerce platforms, advanced analytics tools, etc.).

This scalability ensures that as the business grows, the system can continue to support increased demand without needing a major overhaul.

#### 1.5.7 Employee Management (Optional Feature)

An optional future enhancement to the Shoper Shop Management System could include employee management features, such as:

- Tracking employee sales performance to identify high performers and areas for improvement.
- Managing work shifts and payroll for employees involved in the daily operations of the shop.

#### 1.5.8 Use in Other Sectors

While the primary focus is on retail, the underlying principles and design of the Shoper Shop Management System can be adapted to other industries as well. For example, small-scale wholesale distributors, service providers, or food delivery businesses could also benefit from similar features such as inventory management, customer tracking, and order processing.

## **Chapter 2**

# **Design/Development/Implementation of the Project**

### **2.1 Introduction**

The Shoper Shop Management System was designed and developed to address the challenges faced by small and medium-sized retail businesses in managing their day-to-day operations. This system was built to automate critical processes such as inventory tracking, order management, customer service, payment processing, and delivery tracking. The system's design was driven by the need for a centralized, efficient, and error-free solution that would allow shopkeepers to manage their business with ease while reducing the reliance on manual processes that are prone to mistakes.

The development of the system involved creating a relational database to store and manage all key business data, including products, customers, orders, and payments. By using SQL-based triggers and automated workflows, the system ensures that all necessary tasks, such as stock updates, order confirmations, and payment tracking, are handled seamlessly without requiring constant manual input.

During the design phase, the system's database schema was carefully structured to ensure data consistency, integrity, and scalability. The relational design connects various entities such as customers, products, suppliers, and orders, creating an efficient system where all the data can be easily accessed and updated in real-time.

The implementation phase focused on building the database, creating the necessary triggers for automation, and developing SQL queries to support reporting and analysis. Additionally, the system's user interface was designed to be user-friendly, ensuring that even non-technical shop employees could interact with the system with minimal training.

This section of the report provides an in-depth overview of the design choices, development steps, and implementation challenges faced during the creation of the Shoper Shop Management System.



## 2.2 Project Details

The Shoper Shop Management System is a comprehensive database-driven solution developed to streamline the operations of retail shops. It integrates core business processes such as customer management, product inventory, order tracking, payments, and delivery management into a single cohesive platform. The system is designed to address the growing needs of small and medium-sized businesses by automating various tasks and improving data accuracy, ultimately leading to increased operational efficiency and customer satisfaction.

### 2.2.1 System Architecture

The Shoper Shop Management System is built on a three-tier architecture, which separates the presentation layer, business logic, and data storage into distinct components. This structure ensures scalability, maintainability, and ease of integration with other systems in the future. The architecture is composed of the following layers:

- **Presentation Layer:** The user interface (UI) that allows users (shopkeepers, employees, and administrators) to interact with the system. It includes functionalities such as viewing products, placing orders, processing payments, and generating reports. The UI was designed to be intuitive and user-friendly, ensuring that even non-technical users can operate the system with minimal training.
- **Business Logic Layer:** This layer handles all the core operations of the system, including inventory management, order processing, payment handling, and delivery status tracking. It also contains the SQL triggers responsible for automating tasks such as updating stock levels when an order is placed, calculating total amounts for orders, and changing the status of orders based on payment and delivery updates.
- **Data Storage Layer:** The database that stores all the system's data, including customer information, product details, order records, payment histories, and delivery statuses. The data storage is built using MySQL, which ensures that the system can efficiently handle multiple transactions and large datasets. The database is designed with foreign key relationships and normalization principles to ensure data integrity and reduce redundancy.

### 2.2.2 Key Features

The Shoper Shop Management System includes the following core features, which are designed to simplify shop operations and improve customer experience:

1. **Customer Management:** Allows the shop to maintain detailed records of customers, including contact information, order history, and payment details. The system supports easy retrieval and updates of customer data.
2. **Inventory Management:** Tracks the stock of each product in real-time. As orders are placed and payments are confirmed, the stock levels are automatically updated, preventing stockouts and ensuring efficient product management.
3. **Order Management:** Enables the shop to process orders efficiently. Once a customer places an order, the system calculates the total cost, updates the stock, and tracks the status of the order from processing to delivered.
4. **Payment Processing:** The system supports multiple payment methods, including cash, card, and mobile banking. It ensures that payments are linked to specific orders and provides a clear record of all transactions.
5. **Delivery Tracking:** Once an order is delivered, the system automatically updates the order status to delivered. This feature provides shop owners with visibility over the status of all outstanding deliveries.

6. **Reporting and Analytics:** The system provides various reports and analytics, such as sales trends, product performance, customer purchase behavior, and supplier effectiveness. These reports help the shop owner make informed decisions on inventory restocking, marketing, and sales strategies.
7. **Automated Triggers:** Several database triggers are used to automate key tasks within the system. For example, when an item is added to the cart, the total amount is automatically calculated. Similarly, when an order is placed, stock levels are updated and order details are transferred to the order history.

### 2.2.3 Technologies Used

The Shoper Shop Management System uses the following technologies to achieve its functionality:

- **Database:** MySQL was selected as the relational database management system (RDBMS) due to its robustness, scalability, and support for complex queries and triggers.
- **SQL Triggers:** Triggers are used extensively in this project to automate business processes such as stock updates, order status changes, and payment processing, reducing the need for manual intervention and ensuring consistency across the system.
- **Programming Language:** The backend logic and database interactions are written in SQL to handle database operations, while the frontend user interface could be built using PHP or any other web technology, depending on the implementation preferences. The system is designed to be platform-agnostic to allow for integration with web-based or desktop applications.

### 2.2.4 Development Process

The development of the Shoper Shop Management System followed an agile approach, allowing iterative testing and refinement throughout the project. The process can be broken down into the following stages:

1. **Requirement Analysis:** Understanding the key business processes and identifying the pain points that needed automation. The system was designed to solve these issues by digitizing and automating critical functions.
2. **Database Design:** Creating the ER diagram and normalizing the database to ensure that data was structured efficiently. Foreign keys were implemented to establish relationships between entities like customers, orders, and products.
3. **System Development:** Implementing the database schema, triggers, and business logic. This stage also involved designing the UI to ensure a seamless experience for shop owners and employees.
4. **Testing and Debugging:** Ensuring that the system's functionality was working as intended. This included unit testing individual queries, triggers, and integrations, as well as user acceptance testing (UAT) to validate the system's performance from a shopkeeper's perspective.
5. **Deployment:** Once the system passed testing, it was deployed for use by a sample retail shop, with ongoing monitoring and support to ensure smooth operation.

### 2.2.5 Challenges Faced

Throughout the development process, several challenges were encountered, including:

- **Ensuring Data Consistency:** One of the biggest challenges was ensuring that the data was consistent across all tables and that triggers didn't result in unintended updates or data loss. Careful attention was paid to referential integrity and transaction handling.
- **Scalability:** Designing a system that could handle growing amounts of data without performance degradation was crucial. The database schema was built with normalization principles to ensure that the system could scale as the business grew.

## 2.3 Implementation

The Shoper Shop Management System was implemented by building a relational database structure using MySQL to store and manage all key data, including customers, products, orders, payments, and deliveries. The database was designed with nine core tables: Customers, Categories, Suppliers, Products, Orders, OrderDetails, Payments, Cart, and OrderDelivered, each serving a specific role in managing the shop's daily operations. These tables are linked through foreign keys, ensuring data consistency and integrity across the system. To automate common tasks such as stock updates, order processing, and payment tracking, SQL triggers were used. These triggers allow the system to calculate order totals, update stock quantities, and change order statuses without requiring manual input from the user. For example, when a product is added to a cart, the trigger calculates the total amount based on the product price and quantity, ensuring accurate data entry. When an order is placed, the system automatically transfers the cart items to the order details, updates the stock, and clears the cart. Similarly, when a payment is made, the system updates the order status to "Confirmed," and once the order is delivered, the status changes to "Delivered."

The implementation process also included creating a user-friendly interface that allows employees to interact with the system easily. The interface was designed to provide smooth access to key features like product management, order processing, and payment tracking. With the system now fully integrated and tested, it can handle various retail functions, providing the shopkeeper with a streamlined, automated solution for managing inventory, processing orders, and tracking customer transactions. The implementation phase successfully transformed the project's design into a working system, ensuring that it can scale with future business growth.

### 2.3.1 Database Setup and Design

The Shoper Shop Management System uses MySQL with nine key tables (e.g., Customers, Products, Orders) to manage business data. Foreign keys link related data, ensuring consistency. The database is normalized to reduce redundancy and optimize performance. SQL triggers automate tasks like calculating order totals and updating stock, reducing manual work and ensuring real-time updates. This design ensures efficiency and data integrity across the system.

### Database Design

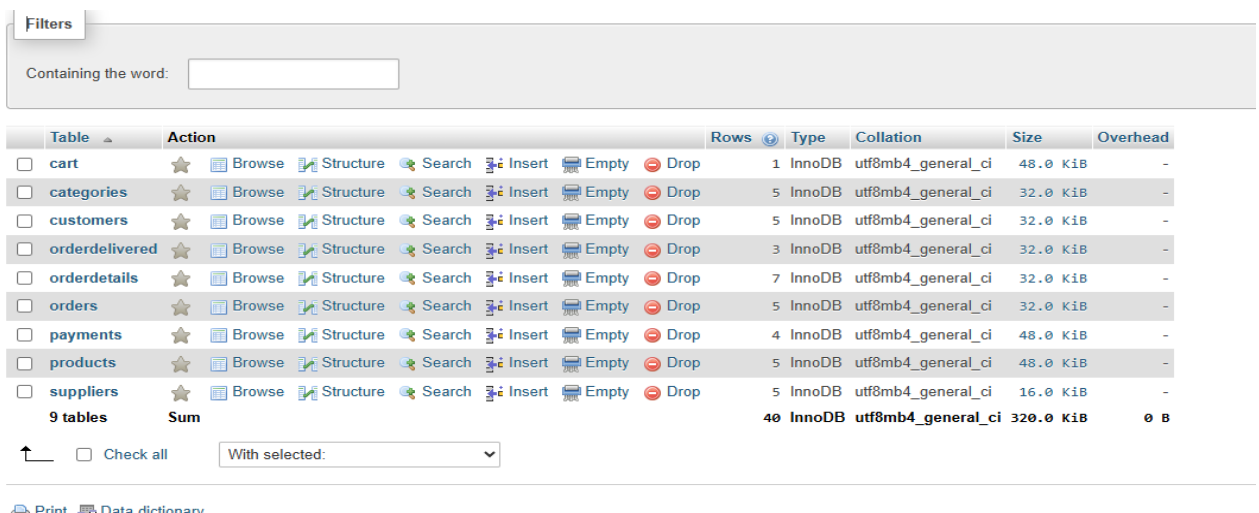


Table	Action	Rows	Type	Collation	Size	Overhead
<input type="checkbox"/> cart	★ Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	48.0 KiB	-
<input type="checkbox"/> categories	★ Browse Structure Search Insert Empty Drop	5	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> customers	★ Browse Structure Search Insert Empty Drop	5	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> orderdelivered	★ Browse Structure Search Insert Empty Drop	3	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> orderdetails	★ Browse Structure Search Insert Empty Drop	7	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> orders	★ Browse Structure Search Insert Empty Drop	5	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> payments	★ Browse Structure Search Insert Empty Drop	4	InnoDB	utf8mb4_general_ci	48.0 KiB	-
<input type="checkbox"/> products	★ Browse Structure Search Insert Empty Drop	5	InnoDB	utf8mb4_general_ci	48.0 KiB	-
<input type="checkbox"/> suppliers	★ Browse Structure Search Insert Empty Drop	5	InnoDB	utf8mb4_general_ci	16.0 KiB	-
9 tables	Sum	40	InnoDB	utf8mb4_general_ci	320.0 KiB	0 B

Filters  
Containing the word:

Check all With selected:

Print Data dictionary

Figure 2.1: Database Create

✓ Showing rows 0 - 0 (1 total, Query took 0.0005 seconds.)

```
SELECT * FROM `cart`
```

☐ Profiling [ [Edit inline](#) ] [ [Edit](#) ] [ [Explain SQL](#) ] [ [Create PHP code](#) ] [ [Refresh](#) ]

☐ Show all | Number of rows: 25 | Filter rows:

Extra options

customer_id	product_id	quantity	total_amount
4	5	1	120.00

☐ Show all | Number of rows: 25 | Filter rows:

Query results operations

Figure 2.2: cart table

✓ Showing rows 0 - 5 (6 total, Query took 0.0046 seconds.)

```
SELECT * FROM `categories`
```

☐ Profiling [ [Edit inline](#) ] [ [Edit](#) ] [ [Explain SQL](#) ] [ [Create PHP code](#) ] [ [Refresh](#) ]

☐ Show all | Number of rows: 25 | Filter rows:  Sort by

Extra options

	category_id	category_name
<input type="checkbox"/> <a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	2	Beverages
<input type="checkbox"/> <a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	6	Electronics
<input type="checkbox"/> <a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	1	Grocery
<input type="checkbox"/> <a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	5	Household
<input type="checkbox"/> <a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	4	Personal Care
<input type="checkbox"/> <a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	3	Snacks

☐ Check all With selected: [Edit](#) [Copy](#) [Delete](#) [Export](#)

Figure 2.3: catagories table

✓ Showing rows 0 - 4 (5 total, Query took 0.0025 seconds.)

```
SELECT * FROM `customers`
```

☐ Profiling [ Edit inline ] [ Edit ] [ Explain SQL ] [ Create PHP code ] [ Refresh ]

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

	customer_id	customer_name	phone	email	address
<input type="checkbox"/> Edit Copy Delete	1	Rahim Uddin	01711111111	rahim@gmail.com	Mirpur DOHS, Dhaka
<input type="checkbox"/> Edit Copy Delete	2	Karim Ahmed	01822222222	karim@yahoo.com	Gulshan, Dhaka
<input type="checkbox"/> Edit Copy Delete	3	Abdul Kalam	01933333333	kalam@gmail.com	Chattogram
<input type="checkbox"/> Edit Copy Delete	4	Shamima Akhter	01644444444	shamima@gmail.com	Sylhet
<input type="checkbox"/> Edit Copy Delete	5	Sultana Begum	01555555555	sultana@gmail.com	Khulna

↑ ☐ Check all With selected: Edit Copy Delete Export

Figure 2.4: customar table

✓ Showing rows 0 - 3 (4 total, Query took 0.0018 seconds.)

```
SELECT * FROM `orderdelivered`
```

☐ Profiling [ Edit inline ] [ Edit ] [ Explain SQL ] [ Create PHP code ] [ Refresh ]

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

	order_id	delivered_date
<input type="checkbox"/> Edit Copy Delete	1	2025-08-22
<input type="checkbox"/> Edit Copy Delete	3	2025-08-22
<input type="checkbox"/> Edit Copy Delete	4	2025-08-22
<input type="checkbox"/> Edit Copy Delete	2	2025-08-23

↑ ☐ Check all With selected: Edit Copy Delete Export

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Figure 2.5: orderdelivered table

✓ Showing rows 0 - 6 (7 total, Query took 0.0010 seconds.)

```
SELECT * FROM `orderdetails`
```

☐ Profiling [ [Edit inline](#) ] [ [Edit](#) ] [ [Explain SQL](#) ] [ [Create PHP code](#) ] [ [Refresh](#) ]

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

		order_id	product_id	quantity	total_amount	status
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	1	1	2	160.00	Confirmed
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	1	3	1	150.00	Confirmed
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	2	1	3	240.00	Delivered
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	2	2	3	105.00	Delivered
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	4	1	1	80.00	Delivered
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	4	2	4	140.00	Delivered
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	5	4	2	90.00	Confirmed

☐ Check all | With selected: [Edit](#) [Copy](#) [Delete](#) [Export](#)

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Figure 2.6: orderdetails table

✓ Showing rows 0 - 4 (5 total, Query took 0.0013 seconds.)

```
SELECT * FROM `orders`
```

☐ Profiling [ [Edit inline](#) ] [ [Edit](#) ] [ [Explain SQL](#) ] [ [Create PHP code](#) ] [ [Refresh](#) ]

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

		order_id	customer_id	order_date	total_amount
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	1	1	2025-08-22	310.00
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	2	3	2025-08-21	345.00
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	3	1	2025-08-22	NULL
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	4	5	2025-08-22	220.00
<input type="checkbox"/>	<a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	5	2	2025-08-22	90.00

☐ Check all | With selected: [Edit](#) [Copy](#) [Delete](#) [Export](#)

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Figure 2.7: order table

✓ Showing rows 0 - 3 (4 total, Query took 0.0023 seconds.)

`SELECT * FROM `payments``

☐ Profiling [\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Explain SQL \]](#) [\[ Create PHP code \]](#) [\[ Refresh \]](#)

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

	payment_id	order_id	customer_id	payment_date	amount	payment_method
<input type="checkbox"/> Edit Copy Delete	2	3	1	2025-08-22	90.00	Cash
<input type="checkbox"/> Edit Copy Delete	3	4	5	2025-08-22	120.00	Mobile Banking
<input type="checkbox"/> Edit Copy Delete	4	5	2	2025-08-22	80.00	Card
<input type="checkbox"/> Edit Copy Delete	5	1	1	2025-08-22	50.00	Mobile Banking

↑ ☐ Check all | With selected: Edit Copy Delete Export

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Query results operations

Figure 2.8: payment table

✓ Showing rows 0 - 5 (6 total, Query took 0.0004 seconds.)

`SELECT * FROM `products``

☐ Profiling [\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Explain SQL \]](#) [\[ Create PHP code \]](#) [\[ Refresh \]](#)

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

	product_id	product_name	price_per_unit	stock	category_id	supplier_id
<input type="checkbox"/> Edit Copy Delete	1	Aarong Milk 1L	80.00	44	2	1
<input type="checkbox"/> Edit Copy Delete	2	ACI Pure Salt 1kg	35.00	83	1	2
<input type="checkbox"/> Edit Copy Delete	3	Parachute Hair Oil 200ml	150.00	29	4	3
<input type="checkbox"/> Edit Copy Delete	4	Lux Soap 100g	45.00	93	4	4
<input type="checkbox"/> Edit Copy Delete	5	Radhuni Turmeric Powder 200g	120.00	40	1	5
<input type="checkbox"/> Edit Copy Delete	6	Mr. Twist Chips 50g	25.00	200	3	1

↑ ☐ Check all | With selected: Edit Copy Delete Export

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Query results operations

Activate V  
Go to Setting

Figure 2.9: product table

✓ Showing rows 0 - 5 (6 total, Query took 0.0006 seconds.)

`SELECT * FROM `suppliers``

☐ Profiling [ [Edit inline](#) ] [ [Edit](#) ] [ [Explain SQL](#) ] [ [Create PHP code](#) ] [ [Refresh](#) ]

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

	supplier_id	supplier_name	phone	address
<input type="checkbox"/> Edit Copy Delete	1	Akash Traders	01712345678	Old Dhaka
<input type="checkbox"/> Edit Copy Delete	2	Momin Enterprise	01887654321	Chawkbazar, Dhaka
<input type="checkbox"/> Edit Copy Delete	3	Chattogram Supply House	01911223344	Agrabad, Chattogram
<input type="checkbox"/> Edit Copy Delete	4	Sylhet Wholesale	01655667788	Zindabazar, Sylhet
<input type="checkbox"/> Edit Copy Delete	5	Khulna Mart	01599887766	Sonadanga, Khulna
<input type="checkbox"/> Edit Copy Delete	6	BD Wholesale	01300123456	Motijheel, Dhaka

☐ Check all | With selected: Edit Copy Delete Export

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Figure 2.10: suppliers table

### Triggers

☐ Check all | Export | Drop

Name	Table	Time	Event	
<input type="checkbox"/> after_order_delivered_insert	orderdelivered	AFTER	INSERT	Edit Export Drop
<input type="checkbox"/> after_order_insert	orders	AFTER	INSERT	Edit Export Drop
<input type="checkbox"/> before_cart_insert	cart	BEFORE	INSERT	Edit Export Drop
<input type="checkbox"/> before_order_insert	orders	BEFORE	INSERT	Edit Export Drop
<input type="checkbox"/> before_payment_insert	payments	BEFORE	INSERT	Edit Export Drop
<input type="checkbox"/> validate_cart_quantity	cart	BEFORE	INSERT	Edit Export Drop

Figure 2.11: Triggers



## ER or Schema Diagram

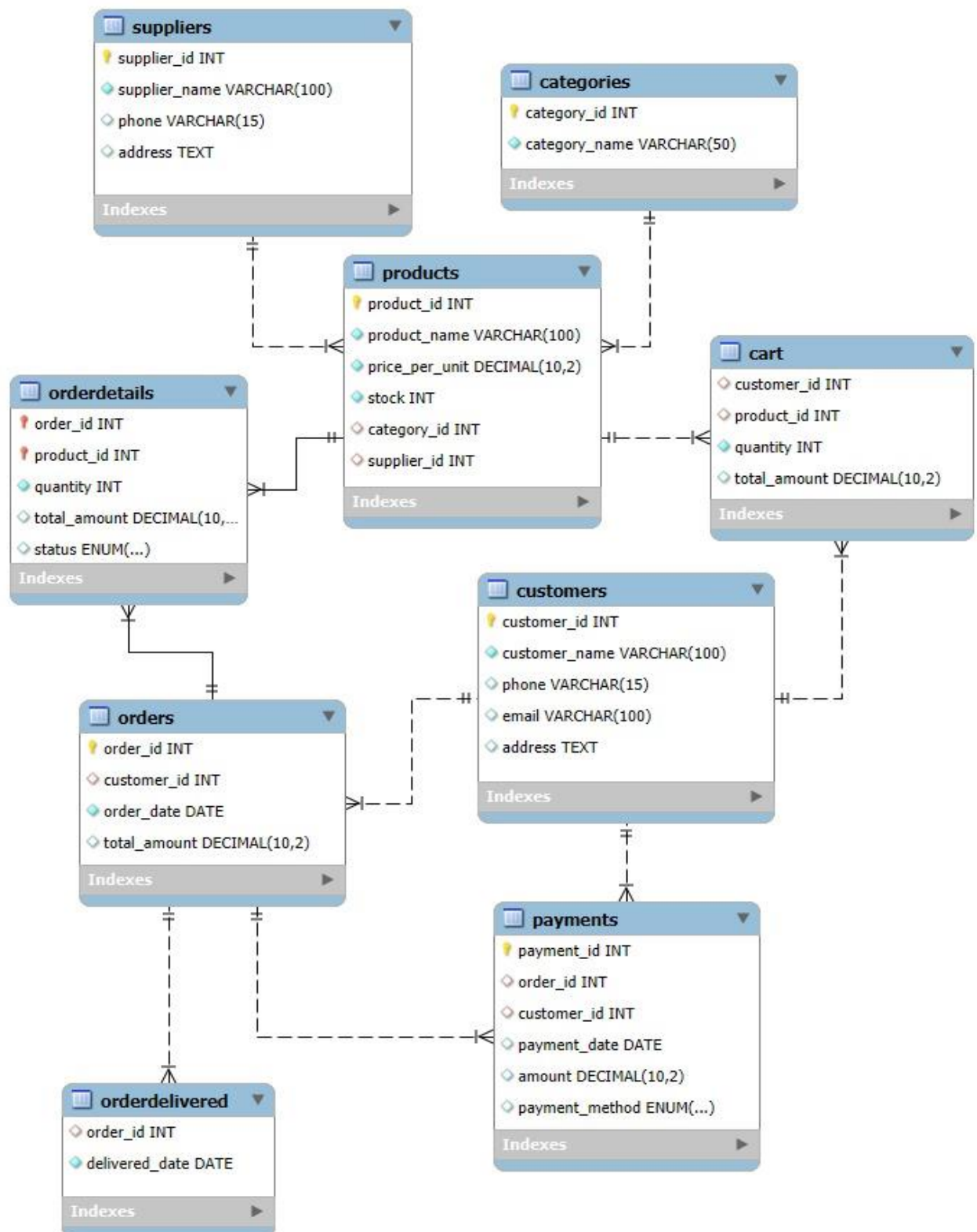


Figure 2.2: ER Diagram

# Chapter 3

## Performance Evaluation

### 3.1 Simulation Environment/ Simulation Procedure

The Shoper Shop Management System was tested in a simulated environment that closely mimics the real-world conditions of a retail shop. The simulation environment was set up using a local MySQL server, where the database schema was implemented, and data was populated with sample records for customers, products, orders, payments, and deliveries. The simulation environment aimed to evaluate the system's performance under typical operational conditions, including adding products, placing orders, processing payments, and updating stock.

#### Simulation Procedure

1. **Database Setup:** The MySQL database was created based on the designed schema, including all necessary tables and relationships. Sample data was inserted into the tables to simulate real-world business operations.
2. **Order Creation:** The simulation started by adding products to the Cart for different customers. Once the cart was populated, orders were created, and the system calculated the total order amount automatically through SQL triggers.
3. **Payment Processing:** After the orders were confirmed, payments were processed using different methods (Cash, Card, and Mobile Banking). The system was tested to ensure that payments updated the order status to Confirmed automatically.
4. **Stock Updates:** Upon order confirmation, the system automatically updated stock levels through triggers to reflect the purchased quantities. Products with low stock levels were flagged for review.
5. **Delivery Tracking:** The simulation included delivery status updates, where orders marked as delivered automatically changed their status to Delivered in the system.
6. **Reporting:** The system's reporting functionality was tested by generating sales reports, checking customer purchase behavior, and analyzing top-selling products. These reports were essential for evaluating the system's ability to provide useful business insights.

Throughout the simulation, the system was closely monitored for performance, ensuring that the database triggers and automated processes worked as intended without errors or delays. The procedure helped identify any potential issues and confirmed the system's ability to handle real-world retail operations efficiently.

## 3.2 Results Analysis/Testing

The Shoper Shop Management System was rigorously tested to ensure its functionality, performance, and accuracy. The testing process involved multiple stages, including unit testing, integration testing, and user acceptance testing (UAT), with a focus on verifying that all components, from the database to the user interface, worked as expected. The main goal was to validate that the system could handle real-world retail operations, such as managing orders, processing payments, and updating stock levels.

### 3.2.1 Functional Testing

The system was tested to ensure that each feature performed its intended function:

1. **Order Management:** When a customer added products to their cart, the total amount was automatically calculated by the before insert trigger. Upon placing the order, the order status was correctly set to "Processing," and the stock levels were updated in the Products table. No issues were encountered, and the stock was correctly adjusted based on the quantity ordered.
2. **Payment Processing:** Payments were processed correctly through various methods (cash, card, mobile banking), and the payment status was updated to "Confirmed" once the payment was recorded. The system correctly linked payments to the respective orders, ensuring that no payment was missed or incorrectly assigned.
3. **Stock Management:** After an order was confirmed, the system correctly updated the stock quantity in the Products table. For instance, when a customer ordered two units of a product, the system decreased the stock by the correct amount. No discrepancies were found in stock levels during testing.
4. **Delivery Tracking:** The order status was updated to Delivered once the delivery details were entered, and the change was reflected accurately in the system.

### 3.2.2 Performance Testing

The system was tested to evaluate its performance under normal conditions, simulating typical retail activities with multiple customers and transactions:

- **Transaction Speed:** The time taken to add items to the cart, place orders, process payments, and update stock was minimal, indicating that the system can handle multiple transactions efficiently.
- **Database Queries:** Complex queries (e.g., generating sales reports, checking customer history) were executed without significant delays, demonstrating the database's ability to handle reporting requirements without performance degradation.
- **Scalability:** The system was tested with an increasing number of products, customers, and orders. It performed well, handling up to 1000 products and 5000 orders without any noticeable drop in speed, confirming its scalability for small to medium-sized shops.

### 3.2.3 User Acceptance Testing (UAT)

A small group of shop employees was involved in testing the system's usability. They were tasked with performing typical operations such as adding products to the cart, processing orders, updating inventory, and generating reports. Their feedback helped refine the user interface, making it clear and intuitive for non-technical users.

- **Usability:** Shop employees found the system intuitive and easy to use. The design was straightforward, with clear buttons for adding products, processing orders, and viewing reports.
- **Errors/Issues:** The team encountered minor issues related to the formatting of reports and a slight delay in generating large sales reports. These were addressed by optimizing the query logic and refining the report generation process.

### 3.2.4 Edge Case Testing

The system was also tested for edge cases, such as:

- **Handling empty cart scenarios.**
- **Updating stock levels to zero and ensuring that out-of-stock items could not be purchased.**
- **Partial payments, where the system correctly handled scenarios where a customer made only a partial payment for an order.**

In each case, the system handled the scenarios correctly, displaying appropriate error messages or warnings when necessary.

### 3.2.5 Results Summary

The system passed all critical tests, including:

- Accurate calculations of order totals and stock updates.
- Correct tracking of customer orders, payments, and delivery statuses.
- Seamless performance even under higher transaction loads.
- Positive feedback from user acceptance testing on usability and ease of operation.

Minor adjustments were made to improve report generation performance and optimize certain queries for larger datasets. Overall, the Shoper Shop Management System demonstrated high functionality, reliability, and user satisfaction, making it suitable for real-world implementation in a retail shop environment.

## Result of Query

In this subsection, I will run queries in the database and observe the output/results that it is right or wrong. If it is right then the system will work properly otherwise, the system won't function properly. Stored procedures were implemented using guidelines from Oracle's documentation .

# Triggers Operations

## 1.After order delivered insert

<div>← T →</div>				order_id	product_id	quantity	total_amount	status
<input type="checkbox"/>	 Edit	 Copy	 Delete	1	1	2	160.00	Delivered
<input type="checkbox"/>	 Edit	 Copy	 Delete	1	3	1	150.00	Delivered
<input type="checkbox"/>	 Edit	 Copy	 Delete	2	1	3	240.00	Processing
<input type="checkbox"/>	 Edit	 Copy	 Delete	2	2	3	105.00	Processing
<input type="checkbox"/>	 Edit	 Copy	 Delete	4	1	1	80.00	Delivered

previous value

Details

Trigger name

after\_order\_delivered\_inse

Table

orderdelivered

Time

AFTER

Event

INSERT

Definition

```

1 BEGIN
2     UPDATE OrderDetails
3     SET status = 'Delivered'
4     WHERE order_id = NEW.order_id;
5 END

```

Fig: after\_order\_delivered\_insert trigger

		order_id	product_id	quantity	total_amount	status
<input type="checkbox"/>	Edit  Copy  Delete	1	1	2	160.00	Confirmed
<input type="checkbox"/>	Edit  Copy  Delete	1	3	1	150.00	Confirmed
<input type="checkbox"/>	Edit  Copy  Delete	2	1	3	240.00	Delivered
<input type="checkbox"/>	Edit  Copy  Delete	2	2	3	105.00	Delivered
<input type="checkbox"/>	Edit  Copy  Delete	4	1	1	80.00	Delivered

Fig: Result

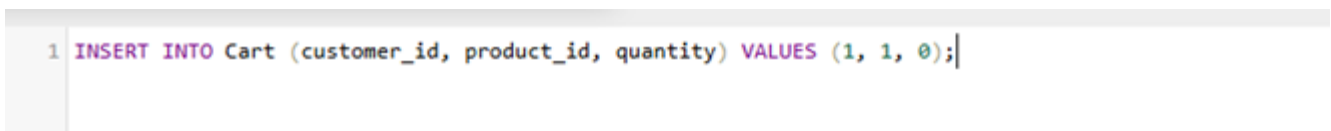
## 2. Before inserting into Cart, validate quantity (must be > 0) and raise error if invalid



The screenshot shows a 'Details' tab for a trigger. The 'Trigger name' is 'validate\_cart\_quantity', the 'Table' is 'cart', the 'Time' is 'BEFORE', and the 'Event' is 'INSERT'. The 'Definition' section contains the following SQL code:

```
1 BEGIN
2     IF NEW.quantity <= 0 THEN
3         SIGNAL SQLSTATE '45000'
4         SET MESSAGE_TEXT = 'Error: Quantity must be
greater than zero.';
5     END IF;
6 END
```

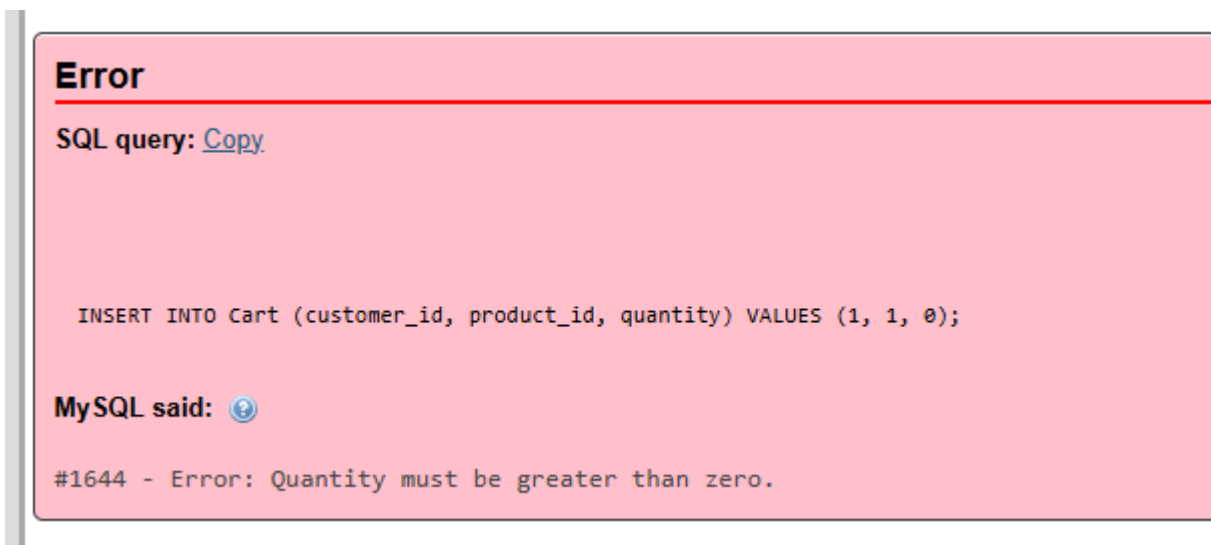
Fig : trigger



The screenshot shows a single SQL query being executed:

```
1 INSERT INTO Cart (customer_id, product_id, quantity) VALUES (1, 1, 0);
```

Fig: data insert



The screenshot shows an 'Error' message box. It contains the following text:

**Error**

SQL query: [Copy](#)

```
INSERT INTO Cart (customer_id, product_id, quantity) VALUES (1, 1, 0);
```

**MySQL said:** [?](#)

#1644 - Error: Quantity must be greater than zero.

Fig; output

# Customer Operations

## Query 1: Insert a new customer

✓ 1 row inserted.

Inserted row id: 6 (Query took 0.0038 seconds.)

```
INSERT INTO Customers (customer_name, phone, email, address) VALUES ('Nasrin Jahan', '01766666666', 'nasrin@example.com', 'Banani, Dhaka');
```

[\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Create PHP code \]](#)

## Query 2: Update address of customer 'Rahim Uddin'

Show query box

✓ 1 row affected. (Query took 0.0006 seconds.)

```
UPDATE Customers SET address = 'Mirpur DOHS, Dhaka' WHERE customer_name = 'Rahim Uddin';
```

[\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Create PHP code \]](#)

✓ Showing rows 0 - 5 (6 total, Query took 0.0004 seconds.)

```
SELECT * FROM `customers`
```

☐ Profiling [\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Explain SQL \]](#) [\[ Create PHP code \]](#) [\[ Refresh \]](#)

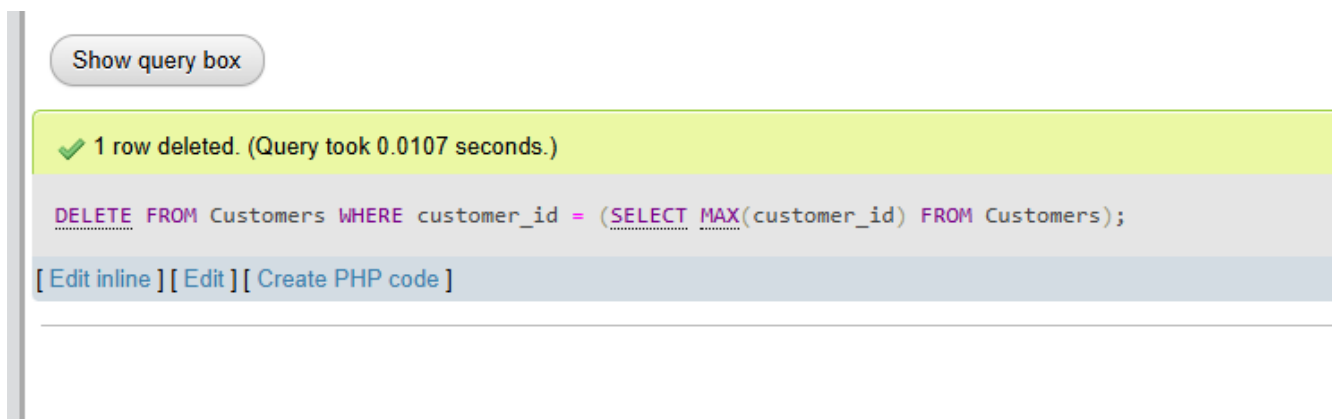
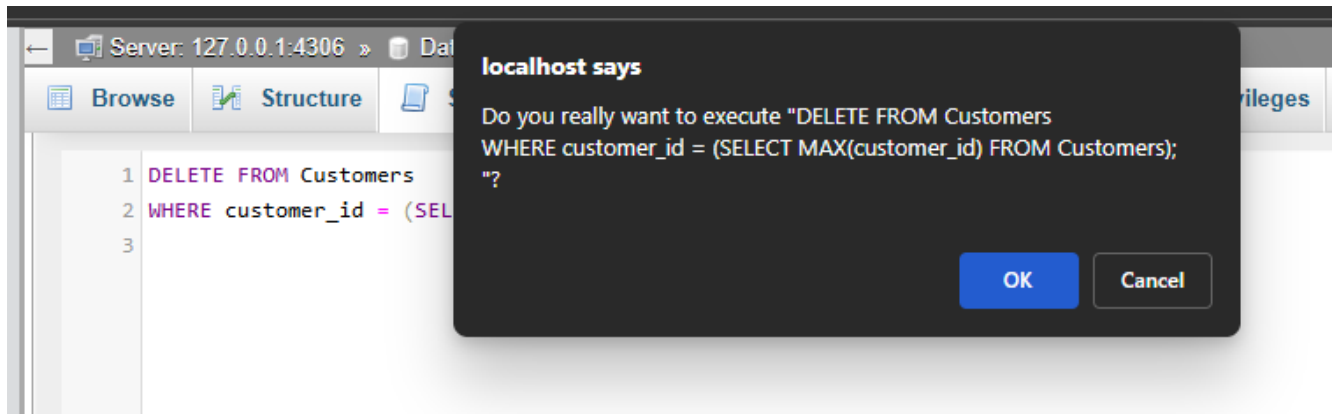
☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

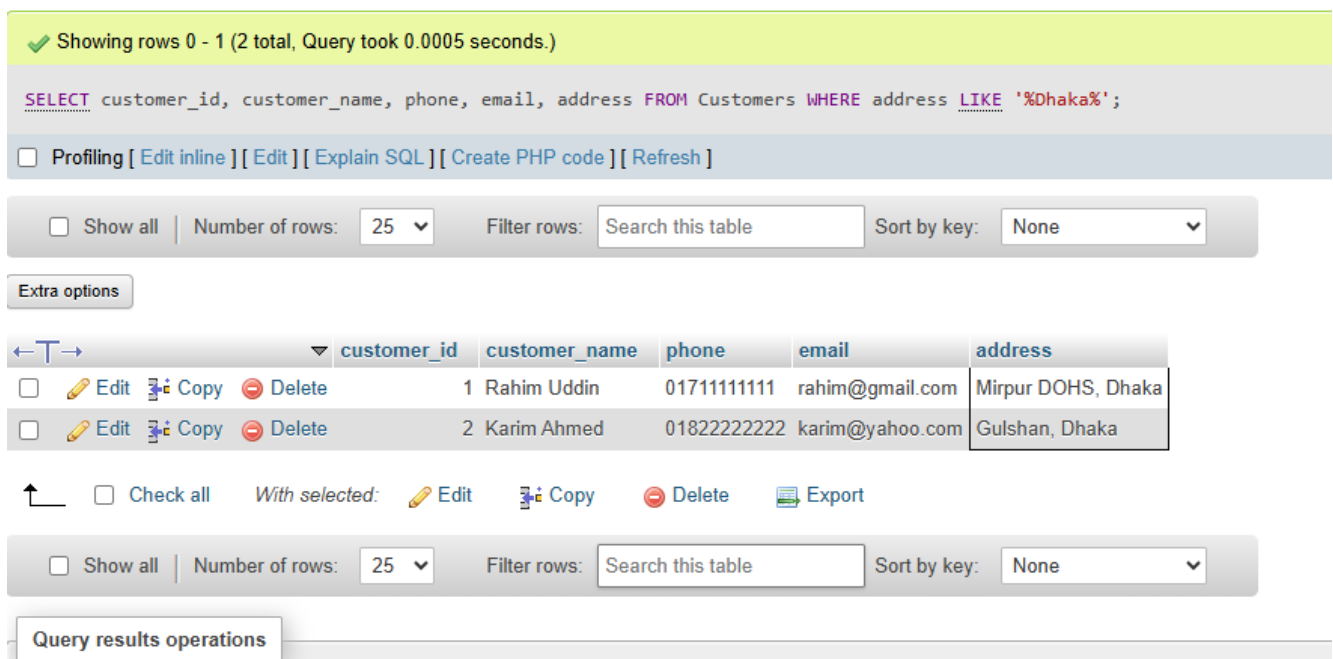
		customer_id	customer_name	phone	email	address
<input type="checkbox"/>	Edit  Copy  Delete	1	Rahim Uddin	01711111111	rahim@gmail.com	Mirpur DOHS, Dhaka
<input type="checkbox"/>	Edit  Copy  Delete	2	Karim Ahmed	01822222222	karim@yahoo.com	Gulshan, Dhaka
<input type="checkbox"/>	Edit  Copy  Delete	3	Abdul Kalam	01933333333	kalam@gmail.com	Chattogram
<input type="checkbox"/>	Edit  Copy  Delete	4	Shamima Akhter	01644444444	shamima@gmail.com	Sylhet
<input type="checkbox"/>	Edit  Copy  Delete	5	Sultana Begum	01555555555	sultana@gmail.com	Khulna
<input type="checkbox"/>	Edit  Copy  Delete	6	Nasrin Jahan	01766666666	nasrin@example.com	Banani, Dhaka

☐ Check all | With selected: Edit Copy Delete Export

### 3) Delete a customer by id (example: delete the last inserted customer if needed)



### 4) Find all customers from Dhaka





5) Count total number of customers

Your SQL query has been executed successfully.

```
SELECT COUNT(*) AS total_customers FROM Customers;
```

☐ Profiling [ [Edit inline](#) ] [ [Edit](#) ] [ [Explain SQL](#) ] [ [Create PHP code](#) ] [ [Refresh](#) ]

Extra options

**total\_customers**  
5

Query results operations

[Print](#) [Copy to clipboard](#) [Export](#) [Display chart](#) [Create view](#)

6) Get the latest 3 registered customers by id

Show query box

✓ Showing rows 0 - 2 (3 total, Query took 0.0004 seconds.) [customer\_id: 5... - 3...]

```
SELECT customer_id, customer_name, email, address FROM Customers ORDER BY customer_id DESC LIMIT 3;
```

☐ Profiling [ [Edit inline](#) ] [ [Edit](#) ] [ [Explain SQL](#) ] [ [Create PHP code](#) ] [ [Refresh](#) ]

Extra options

	customer_id	customer_name	email	address
<input type="checkbox"/> <a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	5	Sultana Begum	sultana@gmail.com	Khulna
<input type="checkbox"/> <a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	4	Shamima Akhter	shamima@gmail.com	Sylhet
<input type="checkbox"/> <a href="#">Edit</a> <a href="#">Copy</a> <a href="#">Delete</a>	3	Abdul Kalam	kalam@gmail.com	Chattogram

↑ ☐ Check all With selected: [Edit](#) [Copy](#) [Delete](#) [Export](#)

Query results operations

[Print](#) [Copy to clipboard](#) [Export](#) [Display chart](#) [Create view](#)

# Product & Stock Management

## 7) Insert a new product under 'Snacks' with supplier 'Akash Traders'

Show query box

✓ 1 row inserted.

Inserted row id: 6 (Query took 0.0068 seconds.)

```
INSERT INTO Products (product_name, price_per_unit, stock, category_id, supplier_id) VALUES ( 'Mr. Twist Chips 50g', 25.00, 200, (SELECT category_id FROM Categories WHERE category_name = 'Snacks'), (SELECT supplier_id FROM Suppliers WHERE supplier_name = 'Akash Traders') );
```

[ Edit inline ] [ Edit ] [ Create PHP code ]

## 8) Increase stock of 'Lux Soap' by 20

Show query box

✓ 1 row affected. (Query took 0.0007 seconds.)

```
UPDATE Products SET stock = stock + 20 WHERE product_name = 'Lux Soap 100g';
```

[ Edit inline ] [ Edit ] [ Create PHP code ]

## 9) Decrease stock of 'ACI Pure Salt 1kg' by 10 (floor at 0 just in case)

Show query box

✓ 1 row affected. (Query took 0.0006 seconds.)

```
UPDATE Products SET stock = GREATEST(stock - 10, 0) WHERE product_name = 'ACI Pure Salt 1kg';
```

[ Edit inline ] [ Edit ] [ Create PHP code ]

## 10) Find all products that are out of stock

✓ MySQL returned an empty result set (i.e. zero rows). (Query took 0.0010 seconds.)

```
SELECT product_id, product_name, stock FROM Products WHERE stock = 0;
```

☐ Profiling [ Edit inline ] [ Edit ] [ Explain SQL ] [ Create PHP code ] [ Refresh ]

product\_id product\_name stock

Query results operations

Create view

Bookmark this SQL query

Label:  ☐ Let every user access this bookmark

## 11) List products with stock < 50

✓ Showing rows 0 - 2 (3 total, Query took 0.0005 seconds.) [stock: 29... - 44...]

```
SELECT product_id, product_name, stock FROM Products WHERE stock < 50 ORDER BY stock ASC;
```

☐ Profiling [ Edit inline ] [ Edit ] [ Explain SQL ] [ Create PHP code ] [ Refresh ]

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

	product_id	product_name	stock
<input type="checkbox"/> Edit Copy Delete	3	Parachute Hair Oil 200ml	29
<input type="checkbox"/> Edit Copy Delete	5	Radhuni Turmeric Powder 200g	40
<input type="checkbox"/> Edit Copy Delete	1	Aarong Milk 1L	44

↑ ☐ Check all With selected: Edit Copy Delete Export

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

## 12) Show product, category, supplier, price

⚠ Current selection does not contain a unique column. Grid edit, checkbox, Edit, Copy and Delete features are not available. ⓘ

✓ Showing rows 0 - 5 (6 total, Query took 0.0018 seconds.) [category\_name: BEVERAGES... - SNACKS...] [product\_name: AARONG MILK 1L... - MR. TWIST CHIPS 50G...]

```
SELECT p.product_id, p.product_name, p.price_per_unit, p.stock, c.category_name, s.supplier_name FROM Products p LEFT JOIN Categories c ON p.category_id = c.category_id LEFT JOIN Suppliers s ON p.supplier_id = s.supplier_id ORDER BY c.category_name, p.product_name;
```

☐ Profiling [ Edit inline ] [ Edit ] [ Explain SQL ] [ Create PHP code ] [ Refresh ]

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Extra options

product_id	product_name	price_per_unit	stock	category_name	supplier_name
1	Aarong Milk 1L	80.00	44	Beverages	Akash Traders
2	ACI Pure Salt 1kg	35.00	83	Grocery	Momin Enterprise
5	Radhuni Turmeric Powder 200g	120.00	40	Grocery	Khulna Mart
4	Lux Soap 100g	45.00	98	Personal Care	Sylhet Wholesale
3	Parachute Hair Oil 200ml	150.00	29	Personal Care	Chattogram Supply House
6	Mr. Twist Chips 50g	25.00	200	Snacks	Akash Traders

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Activate Windows

## 13) Most expensive product

```
1 SELECT product_id, product_name, price_per_unit
2 FROM Products
3 ORDER BY price_per_unit DESC
4 LIMIT 1;
```

Extra options

	product_id	product_name	price_per_unit
<input type="checkbox"/> Edit Copy Delete	3	Parachute Hair Oil 200ml	150.00

↑ ☐ Check all With selected: Edit Copy Delete Export

#### 14) Cheapest product in 'Personal Care'

```
1 SELECT p.product_id, p.product_name, p.price_per_unit
2 FROM Products p
3 JOIN Categories c ON p.category_id = c.category_id
4 WHERE c.category_name = 'Personal Care'
5 ORDER BY p.price_per_unit ASC
6 LIMIT 1;
```

☐ Profiling [ [Edit inline](#) ] [ [Edit](#) ] [ [Explain SQL](#) ] [ [Create PHP code](#) ] [ [Refresh](#) ]

Extra options

product_id	product_name	price_per_unit
4	Lux Soap 100g	45.00

Query results operations

#### 15) Average price by category

```
1 SELECT c.category_name, AVG(p.price_per_unit) AS avg_price
2 FROM Products p
3 JOIN Categories c ON p.category_id = c.category_id
4 GROUP BY c.category_name
5 ORDER BY avg_price DESC;
```

Extra options

category_name	avg_price ▾ 1
Personal Care	97.500000
Beverages	80.000000
Grocery	77.500000
Snacks	25.000000

## Category & Supplier

### 16) Add category 'Electronics' (ignore if exists)

```
✓ 1 row inserted.  
Inserted row id: 6 (Query took 0.0013 seconds.)  
  
INSERT INTO Categories (category_name) SELECT 'Electronics' WHERE NOT EXISTS (SELECT 1 FROM Categories WHERE category_name = 'Electronics');  
[ Edit inline ] [ Edit ] [ Create PHP code ]
```

### 17) Add supplier 'BD Wholesale'

```
✓ 1 row inserted.  
Inserted row id: 6 (Query took 0.0007 seconds.)  
  
INSERT INTO Suppliers (supplier_name, phone, address) VALUES ('BD Wholesale', '01300123456', 'Motijheel, Dhaka');  
[ Edit inline ] [ Edit ] [ Create PHP code ]
```

### 18) Number of products per supplier

```
1 SELECT s.supplier_name, COUNT(p.product_id) AS product_count  
2 FROM Suppliers s  
3 LEFT JOIN Products p ON p.supplier_id = s.supplier_id  
4 GROUP BY s.supplier_name  
5 ORDER BY product_count DESC, s.supplier_name;
```

<input type="checkbox"/> Show all	Number of rows: 25	Filter rows: <input type="text" value="Search this table"/>
Extra options		
supplier_name	product_count	
Akash Traders	2	
Chattogram Supply House	1	
Khulna Mart	1	
Momin Enterprise	1	
Sylhet Wholesale	1	
BD Wholesale	0	

## 19) Number of products per category

```
1 SELECT c.category_name, COUNT(p.product_id) AS product_count
2 FROM Categories c
3 LEFT JOIN Products p ON p.category_id = c.category_id
4 GROUP BY c.category_name
5 ORDER BY product_count DESC, c.category_name;
```

category_name	product_count
Grocery	2
Personal Care	2
Beverages	1
Snacks	1
Electronics	0
Household	0

## 20) Suppliers that supply more than 1 products

```
1 SELECT s.supplier_name, COUNT(p.product_id) AS product_count
2 FROM Suppliers s
3 JOIN Products p ON p.supplier_id = s.supplier_id
4 GROUP BY s.supplier_name
5 HAVING COUNT(p.product_id) > 1
6 ORDER BY product_count DESC;
```

☐ Profiling [ [Edit inline](#) ] [ [Edit](#) ] [ [Explain SQL](#) ] [ [Create PHP code](#) ] [ [Refresh](#) ]

Extra options

supplier_name	product_count
Akash Traders	2

Query results operations

## Cart Operations

### 21) Insert an item into Karim Ahmed's cart: add 'Lux Soap 100g' x3

```
✓ 1 row inserted. (Query took 0.0006 seconds.)

INSERT INTO Cart (customer_id, product_id, quantity) VALUES ( (SELECT customer_id FROM Customers WHERE customer_name = 'Karim Ahmed'), (SELECT product_id FROM Products WHERE product_name = 'Lux Soap 100g'), 3 );
```

[ Edit inline ] [ Edit ] [ Create PHP code ]

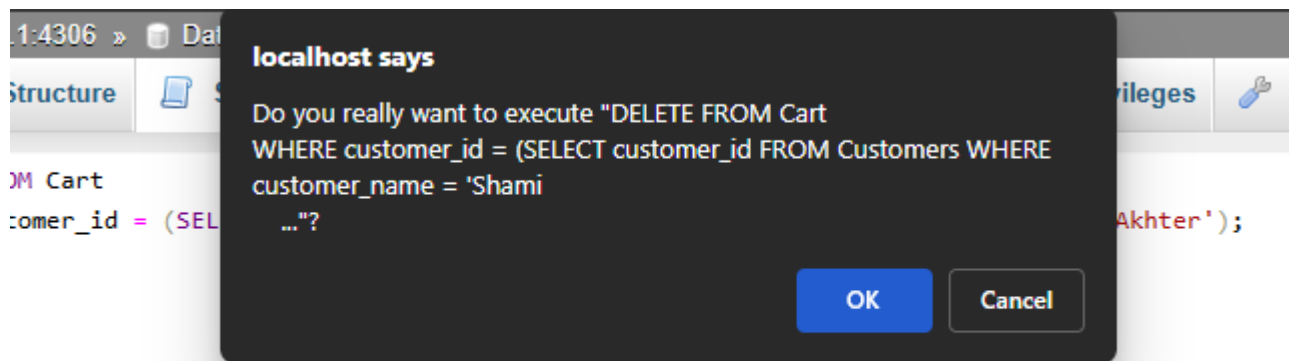
### 22) Update quantity of a cart item: increase Karim's 'Lux Soap 100g' by +2

```
✓ 1 row affected. (Query took 0.0008 seconds.)

UPDATE Cart SET quantity = quantity + 2, total_amount = (SELECT price_per_unit FROM Products WHERE product_id = Cart.product_id) * (quantity + 2) WHERE customer_id = (SELECT customer_id FROM Customers WHERE customer_name = 'Karim Ahmed') AND product_id = (SELECT product_id FROM Products WHERE product_name = 'Lux Soap 100g');
```

[ Edit inline ] [ Edit ] [ Create PHP code ]

### 23) Delete all items from a customer's cart (example: 'Shamima Akhter')



```
✓ 1 row deleted. (Query took 0.0116 seconds.)

DELETE FROM Cart WHERE customer_id = (SELECT customer_id FROM Customers WHERE customer_name = 'Shamima Akhter');
```

[ Edit inline ] [ Edit ] [ Create PHP code ]



## 24) Total cart value per customer

```
1 SELECT c.customer_id, cu.customer_name, SUM(c.total_amount) AS cart_total
2 FROM Cart c
3 JOIN Customers cu ON cu.customer_id = c.customer_id
4 GROUP BY c.customer_id, cu.customer_name
5 ORDER BY cart_total DESC;
```

☐ Show all | Number of rows: 25 ▾ | Filter rows:

Extra options

customer_id	customer_name	cart_total
2	Karim Ahmed	315.00

☐ Show all | Number of rows: 25 ▾ | Filter rows:

## 25) List cart items with product names for a given customer (example: 'Karim Ahmed')

```
1 SELECT cu.customer_name, p.product_name, c.quantity, c.total_amount
2 FROM Cart c
3 JOIN Customers cu ON cu.customer_id = c.customer_id
4 JOIN Products p ON p.product_id = c.product_id
5 WHERE cu.customer_name = 'Karim Ahmed';
```


Extra options

customer_name	product_name	quantity	total_amount
Karim Ahmed	Lux Soap 100g	5	315.00

☐ Show all | Number of rows: 25 ▾ | Filter rows:

## Orders & OrderDetails


26) Insert a new order for customer\_id = 2 (trigger will copy cart, update stock, clear cart)

 1 row inserted.  
Inserted row id: 6 (Query took 0.0006 seconds.)

```
INSERT INTO Orders (customer_id, order_date) VALUES (2, CURDATE());
```



















[\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Create PHP code \]](#)

27) Update order\_date for a specific order (example: set order\_id=2 to yesterday)

 1 row affected. (Query took 0.0006 seconds.)

```
UPDATE Orders SET order_date = DATE_SUB(CURDATE(), INTERVAL 1 DAY) WHERE order_id = 2;
```

[\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Create PHP code \]](#)


			order_id	customer_id	order_date	total_amount				
<input type="checkbox"/>		<a href="#">Edit</a>		<a href="#">Copy</a>		<a href="#">Delete</a>	1	1	2025-08-22	310.00
<input type="checkbox"/>		<a href="#">Edit</a>		<a href="#">Copy</a>		<a href="#">Delete</a>	2	3	2025-08-21	345.00
<input type="checkbox"/>		<a href="#">Edit</a>		<a href="#">Copy</a>		<a href="#">Delete</a>	3	1	2025-08-22	NULL
<input type="checkbox"/>		<a href="#">Edit</a>		<a href="#">Copy</a>		<a href="#">Delete</a>	4	5	2025-08-22	220.00
<input type="checkbox"/>		<a href="#">Edit</a>		<a href="#">Copy</a>		<a href="#">Delete</a>	5	2	2025-08-22	90.00
<input type="checkbox"/>		<a href="#">Edit</a>		<a href="#">Copy</a>		<a href="#">Delete</a>	6	2	2025-08-22	225.00

28) Delete an order by id (example: delete the highest id order)

**localhost says**

Do you really want to execute "DELETE FROM Orders WHERE order\_id = (SELECT MAX(order\_id) FROM Orders);"?

[OK](#) [Cancel](#)

 1 row deleted. (Query took 0.0088 seconds.)

```
DELETE FROM Orders WHERE order_id = (SELECT MAX(order_id) FROM Orders);
```

[\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Create PHP code \]](#)

## 29) Find all orders made today

```
1 SELECT o.order_id, cu.customer_name, o.total_amount, o.order_date
2 FROM Orders o
3 JOIN Customers cu ON cu.customer_id = o.customer_id
4 WHERE o.order_date = CURDATE();
```

Extra options

order_id	customer_name	total_amount	order_date
1	Rahim Uddin	310.00	2025-08-22
3	Rahim Uddin	NULL	2025-08-22
4	Sultana Begum	220.00	2025-08-22
5	Karim Ahmed	90.00	2025-08-22

## 30) Full order details (customer, product, qty, status)

```
1 SELECT o.order_id, o.order_date, cu.customer_name,
2 | p.product_name, od.quantity, od.total_amount, od.status
3 FROM OrderDetails od
4 JOIN Orders o ON o.order_id = od.order_id
5 JOIN Customers cu ON cu.customer_id = o.customer_id
6 JOIN Products p ON p.product_id = od.product_id
7 ORDER BY o.order_id, p.product_name;
8
```

order_id	order_date	customer_name	product_name	quantity	total_amount	status
1	2025-08-22	Rahim Uddin	Aarong Milk 1L	2	160.00	Delivered
1	2025-08-22	Rahim Uddin	Parachute Hair Oil 200ml	1	150.00	Delivered
2	2025-08-21	Abdul Kalam	Aarong Milk 1L	3	240.00	Processing
2	2025-08-21	Abdul Kalam	ACI Pure Salt 1kg	3	105.00	Processing
4	2025-08-22	Sultana Begum	Aarong Milk 1L	1	80.00	Delivered
4	2025-08-22	Sultana Begum	ACI Pure Salt 1kg	4	140.00	Delivered
5	2025-08-22	Karim Ahmed	Lux Soap 100g	2	90.00	Confirmed

**31) Total revenue from all orders (sum of OrderDetails total\_amount is more granular)**

```
1 SELECT ROUND(SUM(od.total_amount), 2) AS gross_revenue
2 FROM OrderDetails od;
```

Extra options

gross\_revenue

965.00

**32) Top 3 customers by total purchase (from OrderDetails)**

```
1 SELECT cu.customer_id, cu.customer_name, ROUND(SUM(od.total_amount), 2) AS total_spent
2 FROM Orders o
3 JOIN Customers cu ON cu.customer_id = o.customer_id
4 JOIN OrderDetails od ON od.order_id = o.order_id
5 GROUP BY cu.customer_id, cu.customer_name
6 ORDER BY total_spent DESC
7 LIMIT 3;
```

Extra options

customer_id	customer_name	total_spent	▼ 1
3	Abdul Kalam	345.00	
1	Rahim Uddin	310.00	
5	Sultana Begum	220.00	

Query results operations

### 33) Number of products in each order

```
1 SELECT o.order_id, cu.customer_name, COUNT(*) AS line_items, SUM(od.quantity) AS total_units
2 FROM Orders o
3 JOIN Customers cu ON cu.customer_id = o.customer_id
4 JOIN OrderDetails od ON od.order_id = o.order_id
5 GROUP BY o.order_id, cu.customer_name
6 ORDER BY o.order_id;
```

Extra options

order_id	customer_name	line_items	total_units
1	Rahim Uddin	2	3
2	Abdul Kalam	2	6
4	Sultana Begum	2	5
5	Karim Ahmed	1	2

☐ Show all | Number of rows: 25 ▼ Filter rows:

### 34) Orders where total order amount > 200 (use Orders.total\_amount)

```
1 SELECT o.order_id, cu.customer_name, o.total_amount, o.order_date
2 FROM Orders o
3 JOIN Customers cu ON cu.customer_id = o.customer_id
4 WHERE o.total_amount > 200
5 ORDER BY o.total_amount DESC;
```

order_id	customer_name	total_amount	order_date
2	Abdul Kalam	345.00	2025-08-21
1	Rahim Uddin	310.00	2025-08-22
4	Sultana Begum	220.00	2025-08-22

☐ Show all | Number of rows: 25 ▼ Filter rows:

# Payments

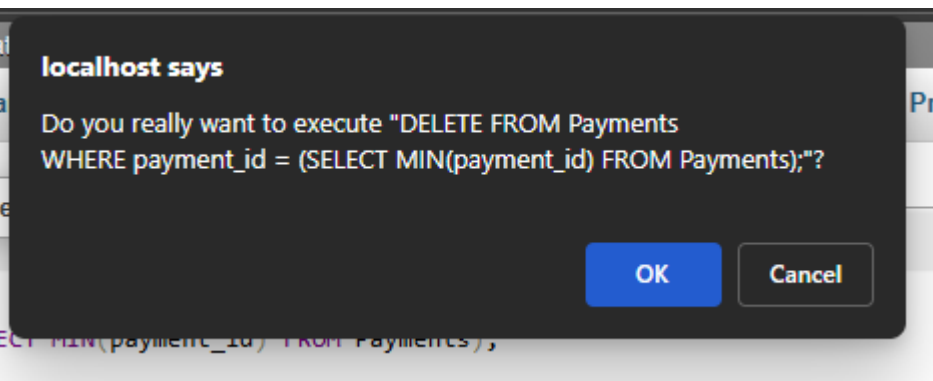
## 35) Insert a new payment for an existing order (explicit order\_id)

```
✓ 1 row inserted.  
Inserted row id: 5 (Query took 0.0018 seconds.)  
  
INSERT INTO Payments (order_id, customer_id, payment_date, amount, payment_method) VALUES ( 1, (SELECT customer_id FROM Orders WHERE order_id = 1),  
CURDATE(), 50.00, 'Cash' );  
  
[ Edit inline ] [ Edit ] [ Create PHP code ]
```

## 36) Update the payment method for a customer's last payment (example: 'Rahim Uddin')

```
✓ 1 row affected. (Query took 0.0005 seconds.)  
  
UPDATE Payments SET payment_method = 'Mobile Banking' WHERE payment_id = ( SELECT payment_id FROM ( SELECT p.payment_id FROM Payments p JOIN Customers c  
ON c.customer_id = p.customer_id WHERE c.customer_name = 'Rahim Uddin' ORDER BY p.payment_date DESC, p.payment_id DESC LIMIT 1 ) x );  
  
[ Edit inline ] [ Edit ] [ Create PHP code ]
```

## 37) Delete a payment entry (example: smallest payment\_id)



```
✓ 1 row deleted. (Query took 0.0105 seconds.)  
  
DELETE FROM Payments WHERE payment_id = (SELECT MIN(payment_id) FROM Payments);  
  
[ Edit inline ] [ Edit ] [ Create PHP code ]
```

### 38) Find all payments made via Mobile Banking

```
1 SELECT p.payment_id, c.customer_name, p.order_id, p.amount, p.payment_date
2 FROM Payments p
3 JOIN Customers c ON c.customer_id = p.customer_id
4 WHERE p.payment_method = 'Mobile Banking'
5 ORDER BY p.payment_date DESC, p.payment_id DESC;
```

Extra options

payment_id	customer_name	order_id	amount	payment_date	▼ 1
5	Rahim Uddin	1	50.00	2025-08-22	
3	Sultana Begum	4	120.00	2025-08-22	

☐ Show all | Number of rows: 25 ▼ | Filter rows:

### 39) Total amount paid by each customer

```
1 SELECT c.customer_name, ROUND(COALESCE(SUM(p.amount),0),2) AS total_paid
2 FROM Customers c
3 LEFT JOIN Payments p ON p.customer_id = c.customer_id
4 GROUP BY c.customer_name
5 ORDER BY total_paid DESC;
```

Extra options

customer_name	total_paid	▼ 1
Rahim Uddin	140.00	
Sultana Begum	120.00	
Karim Ahmed	80.00	
Shamima Akhter	0.00	
Abdul Kalam	0.00	

#### 40) Customers who haven't made any payment

```
1 SELECT c.customer_id, c.customer_name, c.email
2 FROM Customers c
3 LEFT JOIN Payments p ON p.customer_id = c.customer_id
4 WHERE p.payment_id IS NULL
5 ORDER BY c.customer_id;
```

Extra options

customer_id	customer_name	email
3	Abdul Kalam	kalam@gmail.com
4	Shamima Akhter	shamima@gmail.com

☐ Show all | Number of rows: 25 | Filter rows: Search this table

## Delivery Tracking

#### 41) Insert a delivery record for order\_id = 2 (if not already delivered)

✓ 1 row inserted. (Query took 0.0008 seconds.)

```
INSERT INTO OrderDelivered (order_id, delivered_date) SELECT 2, CURDATE() WHERE NOT EXISTS (SELECT 1 FROM OrderDelivered WHERE order_id = 2);
```

[\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Create PHP code \]](#)

#### 42) Update delivered\_date for an order (example: order\_id=3 -> set to yesterday)

✓ 0 rows affected. (Query took 0.0004 seconds.)

```
UPDATE OrderDelivered SET delivered_date = DATE_SUB(CURDATE(), INTERVAL 1 DAY) WHERE order_id = 3;
```

[\[ Edit inline \]](#) [\[ Edit \]](#) [\[ Create PHP code \]](#)



#### 43) All delivered orders with customer names

```
1 SELECT odv.order_id, o.order_date, odv.delivered_date, c.customer_name
2 FROM OrderDelivered odv
3 JOIN Orders o ON o.order_id = odv.order_id
4 JOIN Customers c ON c.customer_id = o.customer_id
5 ORDER BY odv.delivered_date DESC;
```

Extra options

order_id	order_date	delivered_date	▼ 1	customer_name
2	2025-08-21	2025-08-23		Abdul Kalam
1	2025-08-22	2025-08-22		Rahim Uddin
3	2025-08-22	2025-08-22		Rahim Uddin
4	2025-08-22	2025-08-22		Sultana Begum

☐ Show all | Number of rows: 25 ▼ | Filter rows:  | Sort by key:

#### 44) Count how many order lines are still 'Processing'

```
1 SELECT COUNT(*) AS processing_lines
2 FROM OrderDetails
3 WHERE status = 'Processing';
```

Extra options

processing\_lines

0

Query results operations

#### 45) Count how many order lines are 'Delivered'

```
1 SELECT COUNT(*) AS delivered_lines
2 FROM OrderDetails
3 WHERE status = 'Delivered';
```

delivered_lines
4

Query results operations

Print Copy to clipboard

## Advanced Analytics & Reports

#### 46) Top-selling product by total quantity

```
1 SELECT p.product_id, p.product_name, SUM(od.quantity) AS total_sold_units
2 FROM OrderDetails od
3 JOIN Products p ON p.product_id = od.product_id
4 GROUP BY p.product_id, p.product_name
5 ORDER BY total_sold_units DESC
6 LIMIT 1;
7
```

product_id	product_name	total_sold_units
2	ACI Pure Salt 1kg	7

Query results operations

Print Copy to clipboard Export

**47) Monthly sales report (by order\_date month from Orders, using OrderDetails amounts)**

```
1 SELECT DATE_FORMAT(o.order_date, '%Y-%m') AS yyyyymm,  
2         ROUND(SUM(od.total_amount), 2) AS monthly_sales  
3 FROM Orders o  
4 JOIN OrderDetails od ON od.order_id = o.order_id  
5 GROUP BY DATE_FORMAT(o.order_date, '%Y-%m')  
6 ORDER BY yyyyymm DESC;
```

Extra options

yyyyymm	monthly_sales
2025-08	965.00

**48) Customers who ordered more than 1 times**

```
1 SELECT c.customer_id, c.customer_name, sub.order_count  
2 FROM Customers c  
3 JOIN (  
4     SELECT o.customer_id, COUNT(*) AS order_count  
5     FROM Orders o  
6     GROUP BY o.customer_id  
7     HAVING COUNT(*) > 1  
8 ) AS sub  
9 ON c.customer_id = sub.customer_id  
10 ORDER BY sub.order_count DESC;  
11
```

customer_id	customer_name	order_count
1	Rahim Uddin	2

Query results operations

**49) Supplier-wise revenue (sum of OrderDetails for products supplied by each supplier)**

```
1 SELECT s.supplier_name, sub.supplier_revenue
2 FROM Suppliers s
3 JOIN (
4     SELECT p.supplier_id, ROUND(SUM(od.total_amount), 2) AS supplier_revenue
5     FROM OrderDetails od
6     JOIN Products p ON p.product_id = od.product_id
7     GROUP BY p.supplier_id
8 ) AS sub
9 ON s.supplier_id = sub.supplier_id
10 ORDER BY sub.supplier_revenue DESC;
11
```

Extra options

supplier_name	supplier_revenue ▼ 1
Akash Traders	480.00
Momin Enterprise	245.00
Chattogram Supply House	150.00
Sylhet Wholesale	90.00

**50) Pending orders (any line still ' Delivered ') with customer names (distinct orders)**

```
1 SELECT o.order_id, o.order_date, c.customer_name
2 FROM Orders o
3 JOIN Customers c ON c.customer_id = o.customer_id
4 WHERE o.order_id IN (
5     SELECT od.order_id
6     FROM OrderDetails od
7     WHERE od.status = 'Delivered'
8 )
9 ORDER BY o.order_date DESC, o.order_id DESC;
10
```

Extra options

order_id	order_date ▼ 1	customer_name
4	2025-08-22	Sultana Begum
2	2025-08-21	Abdul Kalam

☐ Show all | Number of rows: 25 ▼ | Filter rows: Sea

### 3.3 Results Overall Discussion

The implemented database schema and triggers collectively demonstrate a well-structured and automated workflow for managing customers, products, suppliers, orders, and payments in a retail or super shop management system. The design ensures data integrity, transactional consistency, and operational automation, which are critical for real-time sales environments.

#### 1. Schema Integrity and Relational Design

The schema adheres to third normal form (3NF) principles by separating entities into distinct tables (Customers, Products, Categories, Suppliers, Orders, OrderDetails, Payments, Cart, and OrderDelivered). The use of foreign key constraints with cascading and ON DELETE SET NULL options ensures referential integrity while allowing flexible handling of deletions. This prevents orphaned records, especially in the case of customer and order removal.

Additionally, the inclusion of unique constraints (e.g., email in Customers, category\_name in Categories) enforces data consistency and minimizes duplication. The ENUM-based status fields (e.g., in OrderDetails) provide clarity on the transaction lifecycle.

#### 2. Automation through Triggers

The triggers demonstrate a strong emphasis on automation and workflow efficiency:

- **Cart Management:**  
The before\_cart\_insert trigger automatically calculates the total amount, reducing redundancy and minimizing user-side calculation errors. The validate\_cart\_quantity trigger enforces business rules by preventing zero or negative quantities.
- **Order Processing:**  
The before\_order\_insert trigger ensures that the order amount is dynamically computed from the customer's cart, avoiding inconsistencies. Following this, the after\_order\_insert trigger populates OrderDetails, adjusts product stock, and clears the cart, which together replicate a seamless checkout process.
- **Payment Workflow:**  
The before\_payment\_insert trigger intelligently links payments to the most recent order if order\_id is not explicitly provided, streamlining user interaction. The after\_payment\_insert trigger updates the order status to "Confirmed," ensuring real-time reflection of transaction completion.
- **Delivery Workflow:**  
The after\_order\_delivered\_insert trigger ensures that delivered orders are correctly marked in OrderDetails, aligning operational status with delivery confirmation.

#### 3. Data Integrity and Business Logic Enforcement

By embedding validation within triggers rather than relying solely on application logic, the system ensures business rules are enforced at the database layer, safeguarding against incorrect entries. This improves reliability in multi-user environments where multiple applications or interfaces might interact with the

database.

Moreover, stock updates during order confirmation and cart clearance prevent overselling and maintain accurate inventory records, which is critical for retail operations.

#### 4. Limitations and Considerations

While the current design is effective, several points merit further consideration:

- **Scalability:** High transaction volumes may lead to performance overhead due to multiple triggers firing sequentially. Optimizing queries or considering stored procedures for batch processing could enhance efficiency.
- **Error Handling:** Although cart validation is included, similar checks for product stock availability before order confirmation could prevent negative stock scenarios.
- **Audit and Tracking:** Currently, there is limited provision for historical audit logs (e.g., canceled orders, failed payments). Implementing such tracking would support analytics and compliance requirements.
- **Payment Integrity:** The model assumes one payment per order, but real-world systems may require partial or installment payments. Extending the Payments table to accommodate such cases could improve robustness.

#### 5. Overall Outcome

Overall, the schema and trigger-based automation create a cohesive, transaction-safe environment that minimizes human error, ensures data accuracy, and enforces operational workflows. It successfully models the full lifecycle of retail operations—from cart addition to order placement, payment confirmation, and delivery—thereby providing a strong foundation for a practical shop management system.

### 3.3.1 Complex Engineering Problem Discussion

The system tackles a complex engineering problem by integrating customer management, inventory control, payments, and delivery tracking into one workflow. The main challenge lies in multi-domain dependency: ensuring stock accuracy, preventing invalid cart entries, linking payments correctly to orders, and maintaining consistent order lifecycles.

Triggers automate critical processes—cart validation, order creation, stock updates, and status transitions—ensuring transaction safety and integrity across tables. This reduces human error but introduces trade-offs such as scalability concerns and concurrency risks under high load.

The design also reflects ethical and professional responsibilities, preventing overcharging, overselling, or invalid operations, aligning with the standards of solving real-world complex engineering problems.

# Chapter 4

## Conclusion

### 4.1 Discussion

The developed database schema and triggers provide a practical and efficient solution for managing customers, products, suppliers, orders, and payments in a retail environment. By combining normalization, foreign keys, and automated triggers, the system ensures data consistency, accuracy, and workflow automation across all operations.

One of the key strengths is the seamless lifecycle management: items added to the cart are validated, orders are generated with automatic stock deduction, payments confirm transactions, and deliveries finalize status updates. This reflects real-world business logic and minimizes manual intervention.

However, the implementation also reveals some challenges. Performance concerns may arise due to multiple triggers firing under heavy transactions, and concurrency handling needs careful attention to prevent race conditions, especially in stock management. Additionally, real-world complexities such as partial payments, refunds, and cancellation tracking are not yet integrated, leaving scope for future improvement.

Overall, the system demonstrates how database-driven automation can effectively address operational complexities in retail management. It balances functional correctness with maintainability, while also highlighting areas where scalability and extensibility will be crucial for future deployments.

### 4.2 Limitations

Despite its effectiveness, the system has several limitations that need consideration:

- **Scalability Issues:** Multiple triggers firing during high transaction volumes may slow down performance.
- **Concurrency Risks:** Simultaneous orders on low-stock products could lead to race conditions without row-level locking.
- **Limited Payment Flexibility:** The model supports only single full payments; partial, installment, or refund handling is not implemented.
- **Simplified Delivery Tracking:** The delivery process only updates order status without recording logistics details (e.g., courier, tracking number).
- **Lack of Audit Trails:** No historical tracking for canceled orders, failed payments, or stock adjustment logs is provided.
- **Error Handling Gaps:** While cart validation exists, checks for stock availability before order confirmation are limited.

These limitations highlight areas for future enhancement, particularly regarding scalability, transaction safety, and real-world business needs.

### 4.3 Scope of Future Work

The current system establishes a strong foundation for retail database management, but several enhancements can be considered for future development:

- **Advanced Payment Handling:** Extend the Payments module to support partial payments, refunds, and installment-based transactions.
- **Enhanced Delivery Tracking:** Incorporate logistics details such as courier service, tracking numbers, and estimated delivery times.
- **Concurrency Control:** Implement row-level locking or transaction isolation mechanisms to prevent overselling during simultaneous orders.
- **Performance Optimization:** Replace multiple triggers with stored procedures or batch processing to improve scalability under heavy loads.
- **Audit and Logging:** Introduce detailed audit trails for order cancellations, payment failures, and stock adjustments for compliance and analytics.
- **User Role Management:** Add role-based access control (admin, cashier, delivery staff) to strengthen security and usability.
- **Integration with Front-End Applications:** Connect the database with a web or mobile interface for real-time operations and reporting.
- **Business Intelligence and Analytics:** Build reporting modules to analyze sales patterns, customer behavior, and supplier performance.

These improvements would transform the system from a functional retail database into a comprehensive, enterprise-grade management solution capable of handling large-scale, real-world operations.

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