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**Geo-San Management System: Utilizing Database Operations  
for an Efficient Order and Inventory Management**

**A Project Study Present to the  
College of Informatics and Computing Sciences  
Batangas State University – Lipa**

**In Partial Fulfillment for the requirements of the course  
IT 222 -Advance Database Management System**

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**CHAPTER 1**

**1. INTRODUCTION**

This chapter encompasses the background of the study, the statement of the problem, the statement of objectives, the significance of the study, and the scope and limitations.

**1.1. Background of the Study**

The world is ever-changing, even more so in the competitive and highly volatile business world. In a fast-paced environment where every moment counts, efficient management of product orders and stocks is highly needed. A simple technology implementation would be helpful beyond leaps and bounds compared to the archaic way of using pen and papers. As such, aside from big business corporations who already implement and practice the use of a database management system, even small business owners also look for ways to implement it in their system. Since the usage of technology that revolutionizes traditional methods with practical methods of product order and stock management with the help of database operations would certainly bring about a positive result in the overall efficiency of how the business is running. This statement is also true for bread and pastry businesses like “Geo-San Bakery”. A bread and pastry business that is in need of urgent action and improvement in terms of technological application. In this kind of business, having a proper system in place to monitor and examine how the business is running would be beneficial for the present situation and even more so, in the future. According to (Adedeji, 2020), the main issues with fresh food products are their expiration or their deterioration (if not sold on time) and their loss of sales due to absence of stock (out-stock situations). By having a Database Management System in place, it would give them important and critical data that would be helpful in reducing the left-over products, insufficient stocks, and making future decisions.



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In the study conducted by Menezes, A. et Al, 2023, Inventories are what is called raw materials, actual products, materials and the like that are kept by companies or businesses. They represent a maintenance cost of 20% to 40% of their value per year which has a heavy impact on the organization's budget. Which is why there is a fundamental need to carefully manage inventory. In the study wherein they verify the importance of demand forecasting with direct correlation to inventory management, they have concluded that it is indeed detrimental to the business and does not only affect the said business but also its partner companies.

The Project "Geo-San Management System: Utilizing Database Operations for an Efficient Order and Inventory Management", aims to address these problems that the business operator currently encounters. As a bakery with a diverse selection of bread and pastry products. With the traditional method of pen and paper management in which they simply jot down their expenses and earnings, they are unable to put into useful data the details regarding what type of bread/pastry is the most/least liked by their customers. Also, being the same with other perishable goods, this further leads to generating a loss in income due to the deterioration of bread and pastry products because it was not sold or consumed within a set amount of time. However, with the proposed project in place, this information or data would then be available for them to use as a reference when making future decisions and action plans.

As stated in the project title, the project aims to provide an even more efficient way of order management. In a study by Bhargave, A. et Al (2013), it stated that having a dedicated ordering system has provided the following advantages, ecological improvement as papers are no longer wasted due to transactions being done digitally, short wait time, and overall improvement on customer satisfaction. In the current traditional way of system that "Geo-San Bakery" uses, the business takes in their order manually, meaning the whole process of ordering from their store requires human interaction which then causes inadequate responses for moments where a large



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amount of customers floods in. However, with the help of a dedicated database management system, order taking can be done digitally and hassle-free for the customers and the employees since the workload would be lessened with the help of technology. Additionally, with an already set up order taking place, if in the future they plan to make expansions and delve into the realm of food delivery, this would give them a huge advantage as they already have an existing system. Finally, as the customers use a personal account to order, with the help of the system, the business owners would then be able to develop a strategy for enhancing customer relationship and experience that would expand their horizon and improve personal experience. Therefore, effectively establishing a customer relationship management that would be most helpful in the long run. The necessary details such as the products they sell, the numbers of stocks they produce for each product per day, product prices, how many pieces were sold in a day, how much was the expense for each product, for how much it was sold, and many more. With the Database Management System in place that uses SQL to formulate data, By simply inputting the numbers, they would be able to immediately calculate important data in the quickest way possible. Knowing the exact amount of pieces they sold for each product would give them the general information of what is most/least well received by their consumers, this way they can increase the number of stock for the most well received product and lessen the stocks for the least well received. Furthermore, by taking a look at it from another perspective, they can also check for the most well received product that generates the most profit, with lowest cost of ingredients expenses. Doing this in a daily aspect for a long period of time would generate more reliable information and they can look for specific time frames, months, or days when a product is well received and when it is not. With enough information due to the daily records, sales forecasting can be achieved to predict future sales and avoid overproduction or underproduction of goods and services, misallocation of resources, and poor response times. By doing so, the business can avoid poor outcomes, loss of profit, and losing their customers.



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## **1.2. Statement of the Problem**

This research aims to develop and implement the Geo San Management System, a database-driven solution to optimize inventory control, streamline order processing, and enable delivery capabilities, thereby enhancing the bakery's operational efficiency and customer satisfaction.

### **1.2.1. General Problem**

The Geo-San Management sector faces challenges in achieving optimal operational efficiency due to the absence of a streamlined system that utilizes advanced database operations for order and inventory management.

### **1.2.2. Specific Problems**

- How can the Geo San Management System utilize database operations to improve inventory accuracy, optimize ordering, and maintain optimal stock levels?
- What are the limitations of the current order processing system in terms of accuracy, speed, and customer convenience?
- How can the Geo San Management System leverage database capabilities to streamline order placement, confirmation, and fulfillment, improving customer experience?



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### **1.3. Statement of Objectives**

This research aims to develop and implement the Geo San Management System, a database-driven solution specifically designed for bakeries and similar small businesses.

#### **1.3.1. General Objectives**

To develop and implement a Geo-San Management System that harnesses the power of database operations to address the challenges in order and inventory management, thereby enhancing overall operational efficiency.

#### **1.3.2. Specific Objectives**

- To optimize inventory accuracy, ordering, and stock levels through advanced database functionalities.
- To evaluate and potentially implement delivery capabilities for increased convenience and sales opportunities.
- Streamlining order placement, confirmation, and fulfillment to improve the customer experience.





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**1.4. Significance of the Study**

This study aims for providing efficient order and inventory management of the bakery and its customers through the implementation of a database management system. The findings and implementation can provide valuable insights and practical solutions for small-scale businesses like Geo-San Bakery.

**1. Optimized Operational Efficiency**

Automating order taking and inventory control eliminates the need for manual paperwork, reducing the time and effort required for transaction processing. This enables the bakery to optimize production, minimize waste, and save costs.

**2. Improve Inventory Management**

Tracking inventory levels in real-time and gaining comprehensive insights into stock levels and sales trends, the bakery can reduce the risk of perishable goods deterioration and ensure that products are available when customers demand them, while also enabling better monitoring of product demand, leading to optimized production and minimized waste.

**3. Customer Preference Analysis**

Identify customer preferences and how their products are performing so that they can adequately meet the needs of their clients through their marketing strategies.



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**4. Fast and Accurate Order Processing**

Processing orders quickly and accurately, the bakery can reduce waiting times for customers, leading to increased satisfaction. Customers appreciate efficient service, and minimizing wait times can enhance their overall experience.

**5. Enhanced Accessibility for Consumers**

Adopting digital purchasing channels, like online platforms or mobile apps, the bakery can make it easier for people to buy products quickly and conveniently.

**6. Innovation and Customer Service**

Implementing this system demonstrates the bakery's commitment to innovation and customer service that can enhance the bakery's reputation and attract more customers who value convenience and efficiency.



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**1.5. Scope and Limitations**

This study aims to improve bakery management by introducing a new database system. This system will be designed in such a way that it is easily accessible and user-friendly for both the staff of the bakery and its customers; it will allow them to access product information, place orders, and track deliveries through the bakery's app. Through this system they can keep with the ability to monitor inventory, analyze sales trends, and make decisions about pricing and marketing strategies. However, there might be some problems with the new system such as how much data the system can handle, how it is set up and maintained, and whether it's intuitive enough for everyone to use. We will address these challenges directly as we develop and test the system, ensuring its practicality and user-friendliness.



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**CHAPTER II**

**2. REVIEW OF RELATED LITERATURE**

**2.1. Introduction**

This chapter provides a comprehensive and intensive review on the existing studies and literature related to the effect of having a database management system dedicated for inventory and order management on a bread and pastry shop. It would explain and illustrate the important discoveries, research gaps and sets the fundamental foundations for the project.

**2.2. Review of Related Literatures according to the Research Objectives**

**2.2.1. General Objective**

Musarrat (2021) rightly emphasizes the crucial role of inventory planning within transportation logistics. I fully agree that effective inventory management is all about striking a balance. You need to accurately estimate stock levels, refill timing, and the entire flow from production to final sale. Demand fluctuations make this even harder – customers leave if things are unavailable, but excess stock leads to storage costs and potential clearance sales. Therefore, detailed inventory planning is essential for a streamlined operation. This means consistently forecasting demand, understanding your warehouse capacity, knowing refill lead times, and factoring in carrying costs, returns, and defective goods.



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S.A.A.Ravishan. et Al. (2022) conducted a study entitled “Automated Bakery Management System”. This system utilized Laravel and PHP programming language to implement the automated system for the “Puzzle” bakery that still utilizes traditional methods of data management. Similar to “Geo-San Bakery”, “Puzzle” bakery still uses an outdated handwritten manual system to manage their inventory. Some of the inconveniences that they had before implementing the Automated Bakery Management System include having trouble keeping track of day-to-day records and the increasing number of customers. Upon the successful implementation of the Automated Bakery Management System, the researchers have concluded that the system helped solve the problem of the bakery with the simple implementation. It has helped ease the process of record-keeping and even increase the overall efficiency and productivity of the bakery. In addition, the effectiveness of the implementation aided the bakery in providing order services to the customers via application, resulting in easy and uninterrupted transactions.

**2.2.2. Specific Objective: To optimize inventory accuracy, ordering, and stock levels through advanced database functionalities**

Liew Chee Chung et Al (2019) proposed a system that was developed by using PHP language, AJAX technique, jQuery and SQL. MySQL was used as a database management system while Visual Studio Code was used as text editor. The management process in a bakery done by system is familiar nowadays. The system can assist them by automating most of the repetitive tasks. In future, the automation in the system will keep improving until fewer human resources are required in the process of management.

The system's capability to automate repetitive tasks in bakery management aligns with



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current industry needs, where efficiency and accuracy are paramount. As technology continues to advance, such systems are expected to evolve further, potentially reducing the reliance on human resources for management processes. This progression highlights the ongoing shift towards greater automation and efficiency in bakery operations, offering promising prospects for the future of the industry.

A study for demand forecasting and inventory management as requirements for quality assurance in a bakery company conducted by Menezes, A. et Al., 2023. A qualitative research that aims to understand a phenomena with regards to inventory management, the research collected data in the form of a questionnaire which analyzes the current inventory situation of the target bakery. From the information gathered, the researchers have made use of the data to suggest an ideal purchase frequency for inventory products that would lessen overstocking, stockouts, and other unfavorable incidents. Among others, the researchers also proposed improvement suggestions including technology application to the inventory management to automate and digitalize the computation of inventory data and analyze demand forecasts that would result in the advantage of having reduced risks of breakages and excesses. In conclusion, the research has verified that the lack of demand forecast as well as inadequate data management system ends up influencing the stock management of the bakery, its orders, and financial health.

Therefore, in line with our proposed project of Utilizing Database Operations for an Efficient Order and Inventory Management. This strengthens the idea that having an efficient management system would be overall beneficial to the bakery in the long term practice.



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**2.2.3. Specific Objective: To evaluate and potentially implement delivery capabilities for increased convenience and sales opportunities.**

Online ordering systems should streamline things, but delivery is where the process often breaks down. From a business perspective, it's incredibly frustrating. Delivery staff deal with issues that are out of their control – unavailable customers, inaccurate orders – and it's not just the customer who's unhappy, it drives up costs for everyone. From the study “Automated Bakery Management System” by S.A.A Ravishan. et Al (2022), one of the functionalities they implemented was a delivery system. In which in verbatim, they mention they had to “add the necessary functionalities to the system so that the customers can order their food and make the payment”. This supports the second objective of the proposal which is “To evaluate and potentially implement delivery capabilities for increased convenience and sales opportunities.” Online delivery implementation would bring about new horizons and possibilities for the current state of “Geo-San Bakery”, helping increase income and revenue, aiding customer retention and satisfaction therefore establishing effective relationships with customers by providing ease and access.

**2.2.4. Specific Objective: Streamlining order placement, confirmation, and fulfillment to improve the customer experience.**

Aini Najwa Raside et al (2021), Home-based businesses have become an important source for some families to generate income since the covid-19 pandemic sparked a new normal change that causes a reduction in the income of many families. This project presents the development of an online Bakery Shop Web Application (e-Bakery). This system is implemented based on the case study from the Mama Reni



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Enterprise that makes homemade bakery businesses. The purpose of developing an e-Bakery is to expand advertising on the products and develop an online ordering system on Mama Reni Enterprise as currently Reni Enterprise only works their business via WhatsApp and Facebook.

By using online platforms in today's consumer trends, people prefer buying things online for convenience. This transition will prove how businesses can quickly adapt to what customers want. It also shows that companies are committed to staying competitive and flexible in the business world.

### **2.3. Conclusion**

In conclusion, the proposed project would be beneficial to the Geo-San bakery as it would provide an efficient and productive way of managing their inventory. Loss of profit and inconveniences due to the lack of data and information would be prevented by having a database management system that would serve as a means to provide that information and data in an easy and effective manner. Furthermore, the lack of inconvenience and problems on the inventories would pave way for the expansion of the bakery's range of services. Ordering system and customer relationship management can be explored further to generate more profit and options in order to keep up with the changing times.





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**CHAPTER III**

**3. METHODOLOGY**

**3.1. Introduction**

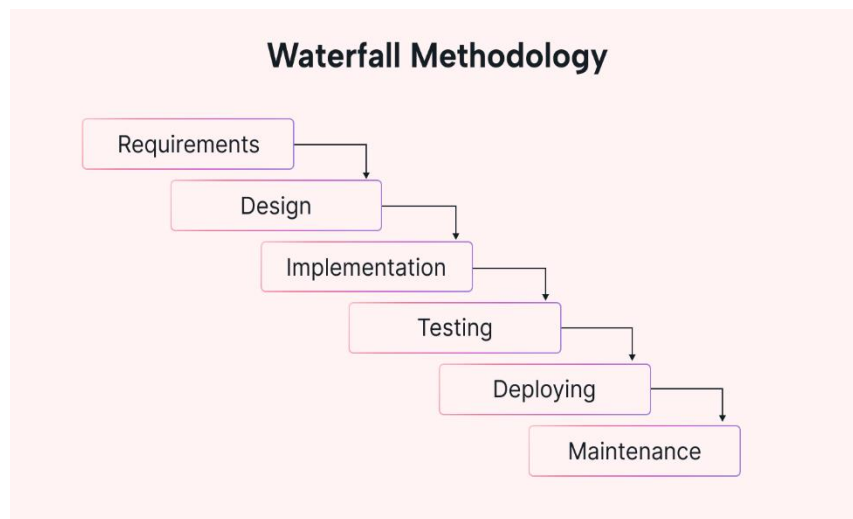


Figure 1. Waterfall Methodology Illustration

In this chapter, we will discuss how the project will be implemented. It will uncover the strategies and plans for integrating the system in the current management of the business to ensure data integrity and security is not tampered nor loss during the transfer and integration. This chapter will further discuss the functionalities of the system to be implemented, how it will be implemented, and features that will be added. The Waterfall Methodology, a traditional and sequential approach to the development process will be utilized. The researchers will make use of the Waterfall Methodology phases named: Analysis (Requirements Gathering), Design, Development (Implementation), Integration and Testing, Deployment (Installation), and Maintenance.



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### **3.2. Analysis (Requirements Gathering)**

During analysis, we gathered info from different sources to understand Geo-San Bakery's operations. We talked with staff, conducted interviews to learn their needs and challenges. This helped us see where the new system can improve, aligning with their goals and fitting into their daily routines.

### **3.3. Design**

The overall design involves three divisions/systems which will be joined together into one whole system. Free and open-source applications will be used to code the system due to budgetary constraints. This will minimize expenses and provide learning experience for the developers/researchers. Virtual Studio Code will be the application used to make a website that would be for admin-only access. This website will provide functionalities for managing the bakery such as inventory dashboard, product information, customer data, profits/losses, among others. NetBeans, IntelliJ, and/or Eclipse IDEs will be used in making an app for the customers use and will provide functionalities such as ordering and providing feedback. Both website and application shall be connected to a single database that would contain all data of the bakery. The database will be a structural database with tables, columns, and rows containing data and shall be created using PostgreSQL application. Simplicity and ease of use will be taken into consideration as the business owner and personnels are unfamiliar with digital technology.



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**Database Design**

Database design undergoes multiple stages of development. First is the unnormalized form wherein the database is still in its raw form, no kind of changes, or form of normalization was applied to the database. The table, columns, and rows in this stage is highly inefficient and most likely unusable. Going through the stages, next is the First Normalization. Through the first normalization, the database achieves its first normal form wherein data atomicity is applied to the tables and columns and multivalued columns are eliminated. Next is the Second Normalization, through this stage composite keys are identified and fixed. Through this stage, we can ensure that all non-primary key columns are fully functionally dependent on the primary key. Lastly, there is the Third Normalization. In this stage the developer looks for transitive dependencies which happens when a non-primary key is functionally dependent on another non-primary key. After going through this stage, the database schema/design is now complete and further modification shall be done after due testing and simulation.



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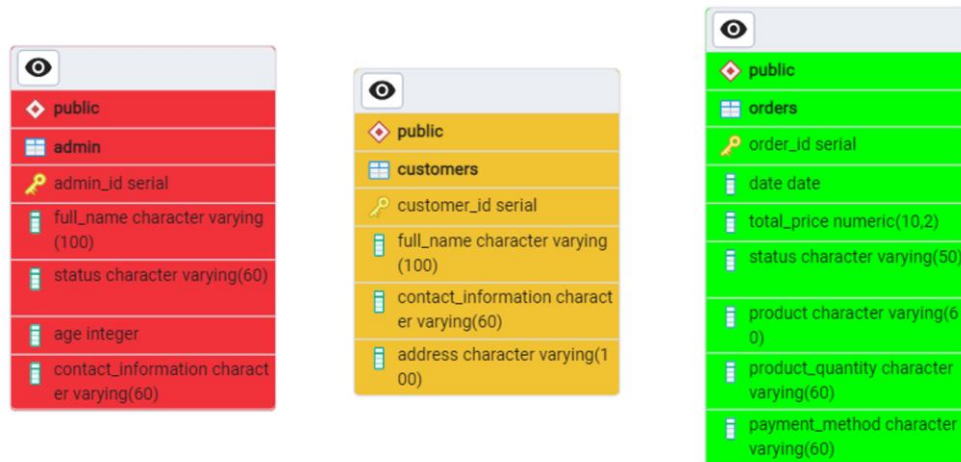


Figure 2. Unnormalized Form ERD

**Unnormalized Form**

The Unnormalized Form / Denormalized Form is the initial database tables and columns devoid of any normalization process. In this form, the database is likely to contain data redundancy, unclear relations from one table to another. It is not yet structured and is viable to many types of anomalies such as insert, update, and delete anomalies.

The Figure 2 which represent the Unnormalized Form ERD of our database does not have the relationships between each table established, the tables/entity contain columns/attribute that is likely to produce multivalued and compound data. For example, the “full\_name” column in tables admin and customers contain a compound data that can lead to anomalies. This can be resolved by separating the values in the column as “first\_name” and “last\_name”. Another characteristic of an unnormalized table is multivalued columns, in the current database, “contact\_information” and “product” columns is likely to have multivalued data. This can be resolved by either creating a separate column or an entirely new table/entity.



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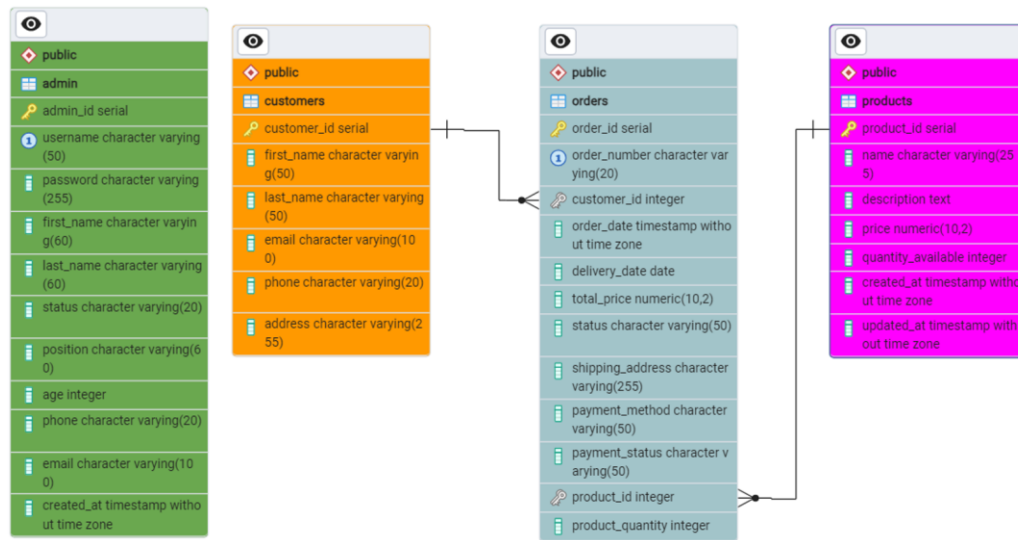


Figure 2. First Normal Form ERD

### First Normal Form

The first normal form of database normalization ensures that data atomicity is absorbed and properly applied in the database and data redundancy are not present. First normal form makes sure that multivalued columns are avoided and no columns are repeated. To do this, a single table can be split into multiple tables so that data atomicity can be applied. In this Illustration, the database currently contains five (5) tables, with no data redundancy, multivalued attributes/columns and no repeated columns. To apply the first normalization on the unnormalized database, the issue found in the columns “full\_name”, “contact\_information”, and “product” were fixed. The “full\_name” columns was separated into two columns namely “first\_name” and “last\_name”. The “contact\_information” column was separated into “phone” and “email” columns. And a separate table was created for products. Furthermore, relationship between each table was established connecting “customers” to “orders” table and “orders” to “products” table.



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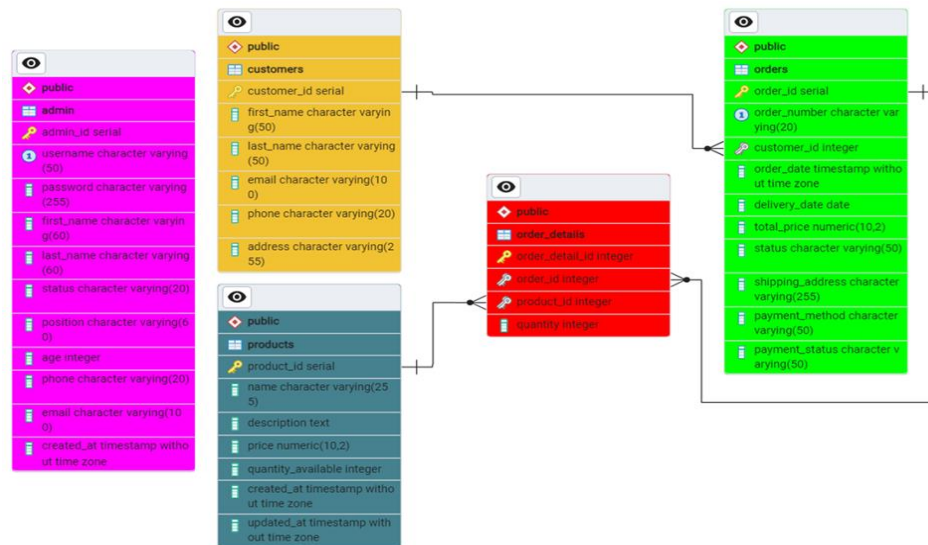


Figure 3. Second Normal Form ERD

## Second Normal Form

To achieve the second normalization, we must ensure that the non-primary key attributes are fully dependent on the primary key of the table. Tables containing composite keys are checked and fixed by separating the table with composite keys into multiple tables which will reduce redundancy and improve search queries. In the first normal form, most tables are already fully functionally dependent on the primary key of each table, therefore, those tables do not currently need to be modified/alterd in the second normal form. However, one table which is the “orders” table contains columns which are not fully functionally dependent on the primary key, the column “product\_quantity” is dependent on the “order\_id” column and “product\_id” column. To resolve this partial dependency, another table called “order\_details” was created. This eliminates the partial dependency on first normal form of table “orders” by creating a separate table for “product\_id” and “quantity” which makes it easier to keep track of inventory when there are multiple unique products bought in a single order.



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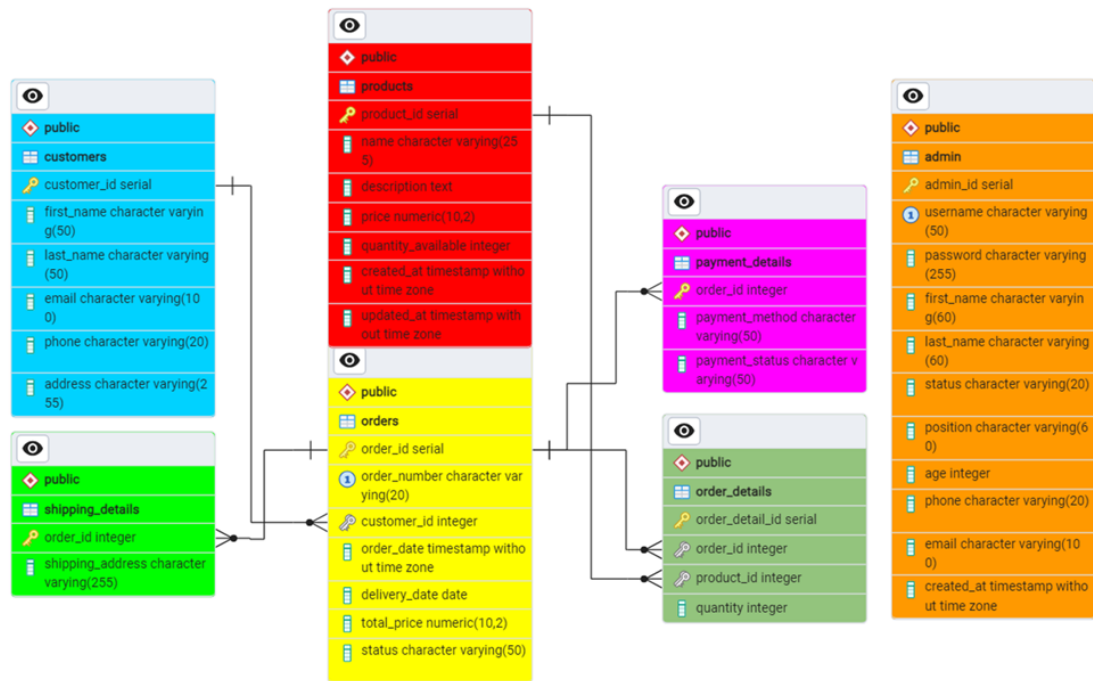


Figure 4. Third Normal Form ERD

### Third Normal Form

The third and final normal form can be done once the second normal form is achieved. The third normal form checks for transitive dependency which means that a column is functionally dependent on a non-primary key attribute, this transitive dependency is likely to lead to data redundancy and insert, search, update, and delete anomalies. Therefore, filtering transitive dependency is important for a functional database. The second normal form currently contains tables that exhibit transitive dependency, specifically, the “orders” table. The “orders” table contains columns “shipping\_address”, “payment\_method”, and “payment\_status” that are not fully functional to the primary key. By separating “shipping\_address”, “payment\_method” and “payment\_status” into their separate tables, this clears the transitive dependency concerns and





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provides clear separation of processes. Shipping\_details table will be helpful in searching and pulling up information from the database related to shipping concerns and the same goes for the payment\_details table. Scalability will also be easy as there is a clear division and distinction between tables.

### **3.4. Development (Implementation)**

The development will involve the actual coding and construction of the bakery management system based on the requirements gathered during the analysis phase. Using the chosen development tools and methodologies, the team will work on translating the system design into functioning software. This includes writing code, creating databases, designing user interfaces, and integrating various components to ensure seamless operation. Regular testing and quality assurance procedures will be conducted throughout the development process to identify and address any issues or bugs.

### **3.5. Integration and Testing**

Integration and Testing phase will be done using the following steps and procedures:

#### **3.5.1. Understanding the business process**

In order to successfully implement the system database into the “Geo-San Bakery” Business, consideration and understanding of their process is important. This will give us, the researchers and system creators the necessary information that will serve as the basis for the system creation. Inefficiencies of the current management system, points to consider, points that do not warrant immediate attention, and points that need to be





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addressed as soon as possible. This information will give direction to the creators of the system so that we can create a suitable system for the business.

### **3.5.2. Data Digitization**

Existing processes that could possibly be absorbed into the system shall be copied and added as a function in the to be implemented system to trigger familiarity and make it easy for the business owner and/or employees to transition from manual pen-paper data management to digital data management.

### **3.5.3. Database Design and Implementation**

A database schema that is in line with the gathered business processes and data shall be created. Simplicity and user-friendly interface shall be prioritized as the business owner and/or employees are not familiar with technology based management.

### **3.5.4. Training**

Basic training and information regarding the system shall be informed to the necessary personnel to fully utilize the efficiency of the system and effectively use it. Suggestions from the users are also highly-encouraged for future updates regarding the system.

### **3.5.5. Security and Data Protection**

Access restrictions, data encryption, and scheduled backups are also added in order to ensure data security and lessen the risk and possibility of data loss.



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### **3.5.6. Basic Tests of Functionality**

Basic tests to check the functionality and usability of the system will be done by the researchers and project facilitators. This will filter out the basic bugs and problems with the initial design and the researchers shall provide a suitable solution or fix for the detected issues.

### **3.5.7. Scalability and Future Updates**

The implemented system will be tested for actual use by the business owner and personnel. Recommendation and other feedback from the users would be taken in order to create a more comprehensive and efficient system in the future. Scalability will be taken into consideration to allow changes in the future.

### **3.6. Deployment (Installation)**

We use five strategies before and after the deployment.

**Database Setup:** Configure and set up the database for your bakery system. Ensure that the database schema is in sync with the application code.

**User Training:** Train the bakery staff or relevant personnel on how to use the system effectively. Provide documentation and support resources.

**Testing:** Conduct thorough testing in the production environment. [Test functionality, performance, and security to identify and address any issues.]



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**Monitoring and Logging:** Implement monitoring tools to track the performance and health of your bakery system. Set up logs to record events and errors for troubleshooting.

**Backup and Recovery:** Implement regular backup procedures to ensure data integrity. Set up a recovery plan in case of system failures.

### 3.7. Maintenance

We use five strategies for maintaining our bakery management system.

**Implement Data Entry Procedures:** Establish standardized procedures for entering our data into the bakery management system. We train our staff on how to accurately input information to ensure consistency and reliability.

**Organize Data Categories:** We categorize our data into relevant categories such as sales, inventory, recipes, customer information, employee records, and financial data. This makes it easier to access and manage information efficiently.

**Updates and manual checking:** To keep our bakery management up to date with the latest patches and updates. Regularly maintain and optimize our data to ensure optimal performance and reliability.

**Monitor Data Quality:** Regularly review our data for accuracy, completeness, and consistency. Identify and correct any errors or discrepancies to maintain data integrity.



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**Regular Data Backup:** Schedule regular backups of your bakery data to prevent loss in case of system failures, cyber attacks, or other unexpected events. Store backups securely, either on-site or off-site.



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