Final Project Report

R&J Burgers

Restaurant Management System

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Overview

The goal of the project is to create an application for a restaurant based on a given business rules as well as with some assumptions necessary for the better implementation. The application consists of a database and a client application.

Results

The Database was built for a restaurant management system.

- Tables were normalized to BCNF.
- Table indexes were created to increase queries efficiency.
- The cost of the various queries was calculated.

UI was built to perform various operations for the restaurant management system. The application has the below features.

- Manage Employees - Add/Modify/Delete
- Manage Customers - Add/ Modify/Delete
- Manage Orders - Add/Modify/Delete
- Manage Delivery Areas - Add/Modify/Delete

Business rules

1) Fast-food restaurant “R&J Burgers” is based in Plano, serves burgers, sides, and non-alcoholic beverages
2) Apart from providing food facility at their own premise, the restaurant takes orders online through its site. Phone orders are also entertained.
3) No servers on the premises, guests serve themselves.

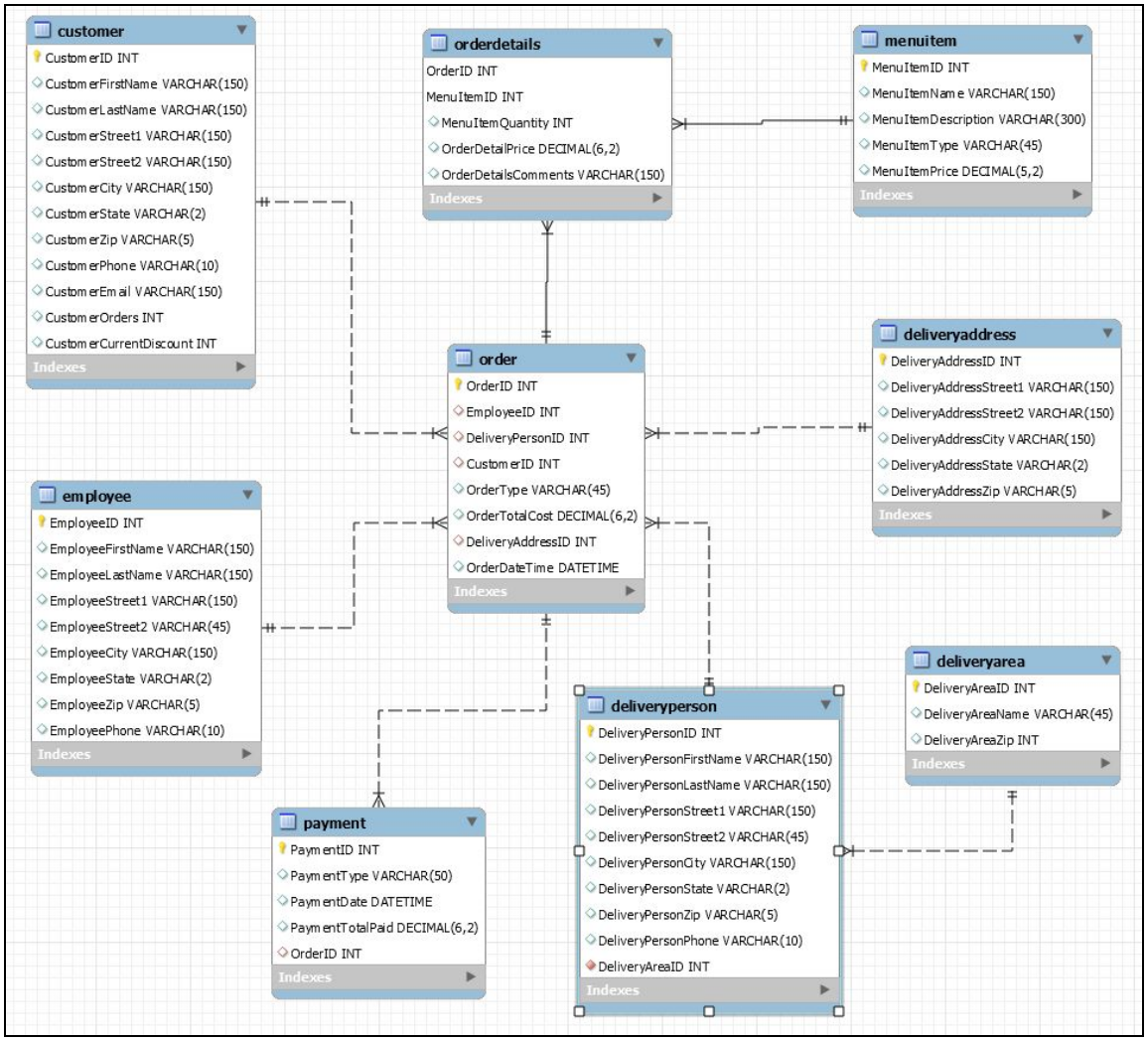
4) Each employee of restaurant trained to perform several duties:
    a. takes orders (on premises, online, on phone),
    b. accepts payments,
    c. assembles orders,
    d. gives orders to customers or assigns deliveries to delivery personnel
5) To deliver the orders, the restaurant has delivery personnel. Each delivery person is assigned to a specific area code. The delivery person can deliver only to the assigned area. Delivery is possible in the area within 15 miles radius.
6) An order can either be DINE-IN or TAKE-OUT order.
7) A customer record is maintained so that premium customers can be awarded discounts. There are 3 types of discounts:
    a. for customers who made 10 – 30 orders – 3%
    b. for customers who made 31 – 50 orders – 5%
    c. for customers who made 51 – and more – 7%

Implementation Technologies

Purpose	Technology
Database	MySQL 8.0.2 (Community Edition)
Database GUI Tool	MySQL Workbench 8.0.21
Backend	Java/J2EE 1.8, Servlet, JDBC, Maven
User Interface	HTML 5, JSP, JavaScript, CSS
Web Server	Apache Tomcat 8.5.59

Database Design

Schema

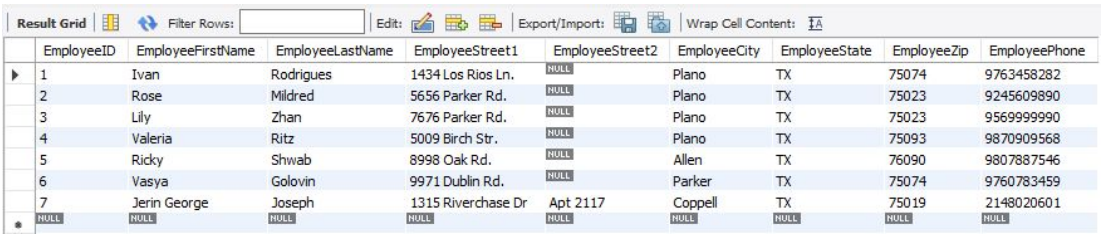


The r_j_burgers database includes 9 relations which show only "order - delivery" activities of a restaurant's business:

1) Customer

CustomerID	CustomerFirstName	CustomerLastName	CustomerStreet1	CustomerStreet2	CustomerCity	CustomerState	CustomerZip	CustomerPhone	CustomerEmail	CustomerOrders	CustomerCurrentDiscount
1	Jack	Brown	2321 Jupiter Rd.	NULL	Plano	TX	75023	9253162455	Brown.Jack@gmail.com	NULL	3
2	Mike	Levy	1717 Parker Rd.	NULL	Plano	TX	75023	9172341717	bblevy@yahoo.com	NULL	5
3	Jennifer	Lowis	1344 Los Rios Ln.	NULL	Plano	TX	75074	9144442567	jlowis@gmail.com	NULL	3
4	Mike	Proditov	1456 Coit Rd.	NULL	Plano	TX	75075	9543171298	mpmpp@outlook.com	NULL	3
5	Sy	Lee	7865 Legacy Dr.	NULL	Plano	TX	75025	9180054335	sylee@outlook.com	NULL	3
6	Lara	De Ane	7878 Blackjack St.	NULL	Plano	TX	75074	9251789696	deAne@gmail.com	NULL	7
7	Natalia	Oliveira	5653 Los Rios Ln.	NULL	Plano	TX	75074	9876565653	noliveira@yahoo.com	NULL	7
8	John	Ross	5412 Spring Creek Pkwy.	NULL	Plano	TX	75093	9169993452	mrjohn@gmail.com	NULL	5
9	Ding	Ping	6517 Legacy Dr.	NULL	Plano	TX	75025	9186563434	dingping@outlook.com	NULL	7
10	Denis	Tekhnenko	1515 Coldwater Creek Ln.	NULL	Plano	TX	75074	9403127547	bigden@gmail.com	NULL	3
11	Jerin George	Joseph	1315 Riverchase Dr	Apt 2117	Coppell	TX	75019	2148020601	jeringeorge@gmail.com	2	3

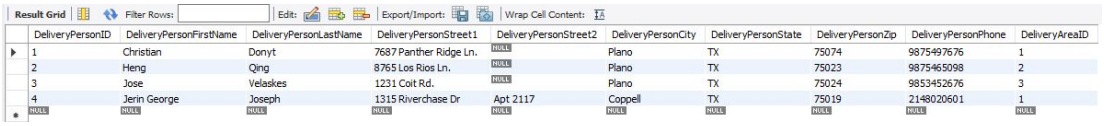
2) Employee



EmployeeID	EmployeeFirstName	EmployeeLastName	EmployeeStreet1	EmployeeStreet2	EmployeeCity	EmployeeState	EmployeeZip	EmployeePhone
1	Ivan	Rodrigues	1434 Los Rios Ln.	NULL	Plano	TX	75074	9763458282
2	Rose	Mildred	5656 Parker Rd.	NULL	Plano	TX	75023	9245609890
3	Lily	Zhan	7676 Parker Rd.	NULL	Plano	TX	75023	9569999990
4	Valeria	Ritz	5009 Birch Str.	NULL	Plano	TX	75093	9870909568
5	Ricky	Shwab	8998 Oak Rd.	NULL	Allen	TX	76090	9807887546
6	Vasya	Golovin	9971 Dublin Rd.	NULL	Parker	TX	75074	9760783459
7	Jerin George	Joseph	1315 Riverchase Dr	Apt 2117	Coppell	TX	75019	2148020601

3) DeliveryPerson

The delivery person details are maintained independently from the Employees because they participate in relationships that are unique. Every delivery person is assigned to a delivery area, and to only one delivery area.

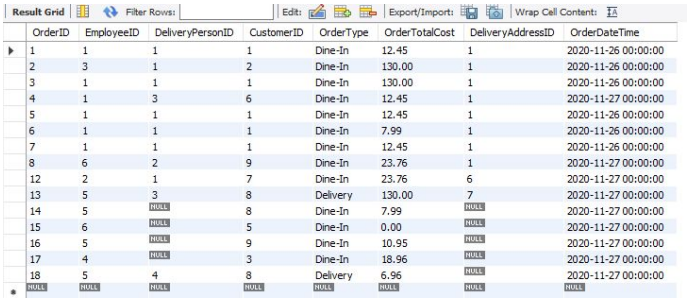


DeliveryPersonID	DeliveryPersonFirstName	DeliveryPersonLastName	DeliveryPersonStreet1	DeliveryPersonStreet2	DeliveryPersonCity	DeliveryPersonState	DeliveryPersonZip	DeliveryPersonPhone	DeliveryAreaID
1	Christian	Donyt	7687 Panther Ridge Ln.	NULL	Plano	TX	75074	9875497676	1
2	Heng	Qing	8765 Los Rios Ln.	NULL	Plano	TX	75023	9875465098	2
3	Jose	Velaskes	1231 Coit Rd.	NULL	Plano	TX	75024	9853452676	3
4	Jerin George	Joseph	1315 Riverchase Dr	Apt 2117	Coppell	TX	75019	2148020601	1

4) DeliveryArea

DeliveryAreaID	DeliveryAreaName	DeliveryAreaZip
1	Carrolton	75092
2	Lewisville	75067
3	Coppell	75019
4	Plano East	75092
5	Plano West	75093

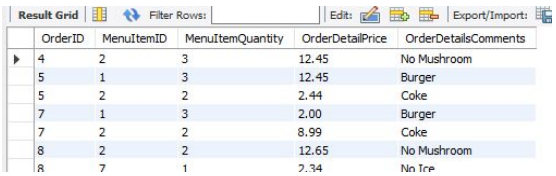
5) Orders



OrderID	EmployeeID	DeliveryPersonID	CustomerID	OrderType	OrderTotalCost	DeliveryAddressID	OrderDateTime
1	1	1	1	Dine-In	12.45	1	2020-11-26 00:00:00
2	3	1	2	Dine-In	130.00	1	2020-11-26 00:00:00
3	1	1	1	Dine-In	130.00	1	2020-11-26 00:00:00
4	1	3	6	Dine-In	12.45	1	2020-11-27 00:00:00
5	1	1	1	Dine-In	12.45	1	2020-11-26 00:00:00
6	1	1	1	Dine-In	7.99	1	2020-11-26 00:00:00
7	1	1	1	Dine-In	12.45	1	2020-11-26 00:00:00
8	6	2	9	Dine-In	23.76	1	2020-11-27 00:00:00
12	2	1	7	Dine-In	23.76	6	2020-11-27 00:00:00
13	5	3	8	Delivery	130.00	7	2020-11-27 00:00:00
14	5	NULL	8	Dine-In	7.99	NULL	2020-11-27 00:00:00
15	6	NULL	5	Dine-In	0.00	NULL	2020-11-27 00:00:00
16	5	NULL	9	Dine-In	10.95	NULL	2020-11-27 00:00:00
17	4	NULL	3	Dine-In	18.96	NULL	2020-11-27 00:00:00
18	5	4	8	Delivery	6.96	NULL	2020-11-27 00:00:00

6) OrderDetails

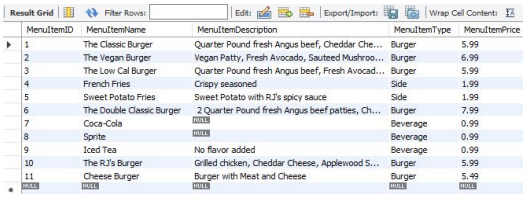
The table was introduced to avoid a many-to-many relationship between the Orders and MenuItem tables.



OrderID	MenuItemID	MenuItemQuantity	OrderDetailPrice	OrderDetailsComments
4	2	3	12.45	No Mushroom
5	1	3	12.45	Burger
5	2	2	2.44	Coke
7	1	3	2.00	Burger
7	2	2	8.99	Coke
8	2	2	12.65	No Mushroom
8	7	1	2.34	No Ice

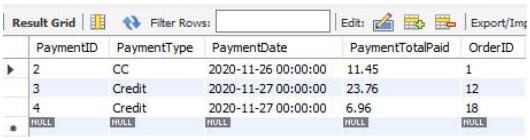
7) MenuItem

The list of items in the menu is stored in the MenuItem table. The price of each item is stored in this table. When the menu items are added to the order, the application uses this price to calculate the total.



MenuItemID	MenuItemName	MenuItemDescription	MenuItemType	MenuItemPrice
1	The Classic Burger	Quarter Pound fresh Angus beef, Cheddar Che...	Burger	5.99
2	The Vegan Burger	Vegan Patty, Fresh Avocado, Sauteed Mushroo...	Burger	6.99
3	The Low Cal Burger	Quarter Pound fresh Angus beef, Fresh Avocad...	Burger	5.99
4	French Fries	Crispy seasoned	Side	1.99
5	Sweet Potato Fries	Sweet Potato with RJ's spicy sauce	Side	1.99
6	The Double Classic Burger	2 Quarter Pound fresh Angus beef patties, Ch...	Burger	7.99
7	Coca-Cola	NULL	Beverage	0.99
8	Sprite	NULL	Beverage	0.99
9	Iced Tea	No flavor added	Beverage	0.99
10	The RJ's Burger	Grilled chicken, Cheddar Cheese, Applewood S...	Burger	5.99
11	Cheese Burger	Burger with Meat and Cheese	Burger	5.49
NULL	NULL	NULL	NULL	NULL

8) Payment



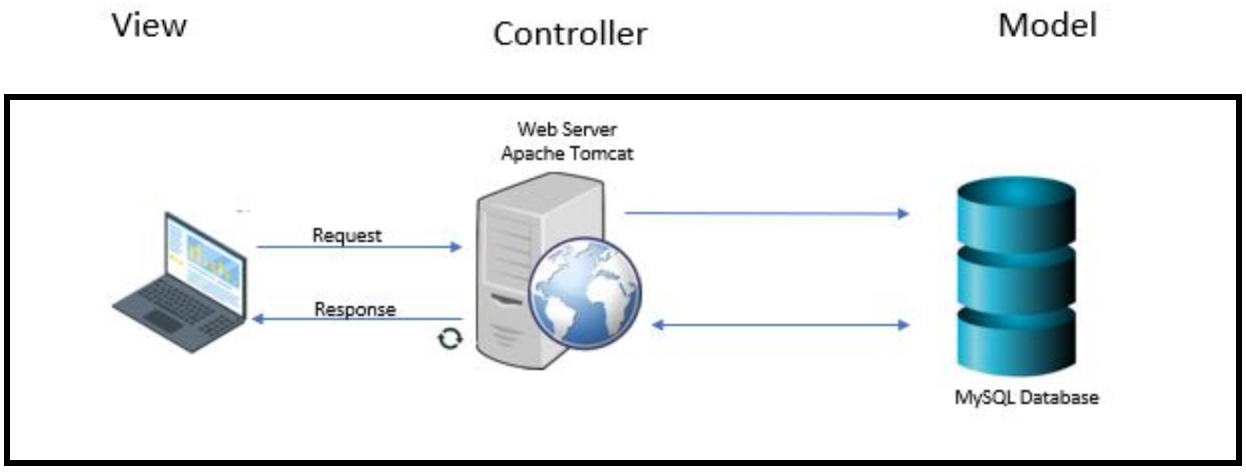
PaymentID	PaymentType	PaymentDate	PaymentTotalPaid	OrderID
2	CC	2020-11-26 00:00:00	11.45	1
3	Credit	2020-11-27 00:00:00	23.76	12
4	Credit	2020-11-27 00:00:00	6.96	18
NULL	NULL	NULL	NULL	NULL

9) DeliveryAddress

The table enhances flexibility of the Database since the customer address could differ from the delivery address.

Application Design

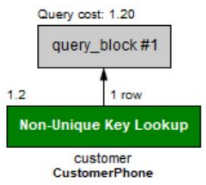
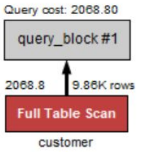
The application follows the MVC (Model - View - Controller) Architecture, where the model, controller and view is separated into distinct layers.



Analysis

1) in terms of speed:

Index on phone number column (customer table) was used to demonstrate how speed of queries depends on indexes. Results are in the below table:

Query	SELECT * FROM_j_burgers.customer WHERE r_j_burgers.customer.CustomerPhone = "9172341717";	SELECT * FROM_j_burgers.customer ignore index (CustomerPhone) WHERE r_j_burgers.customer.CustomerPhone = "9172341717";
Results (seconds)	starting 0.000173 checking permissions 0.000018 Opening tables 0.000053 init 0.000094 System lock 0.000030 optimizing 0.000031 statistics 0.000249 preparing 0.000032 executing 0.000013 Sending data 0.000142 end 0.000011 query end 0.000018 closing tables 0.000017 freeing items 0.000120 cleaning up 0.000027	starting 0.000132 checking permissions 0.000014 Opening tables 0.000033 init 0.000058 System lock 0.000017 optimizing 0.000019 statistics 0.000040 preparing 0.000023 executing 0.000009 Sending data 0.023235 end 0.000018 query end 0.000018 closing tables 0.000017 freeing items 0.000176 cleaning up 0.000027
Query Cost		

Type of Index is BTREE by default in MySQL:

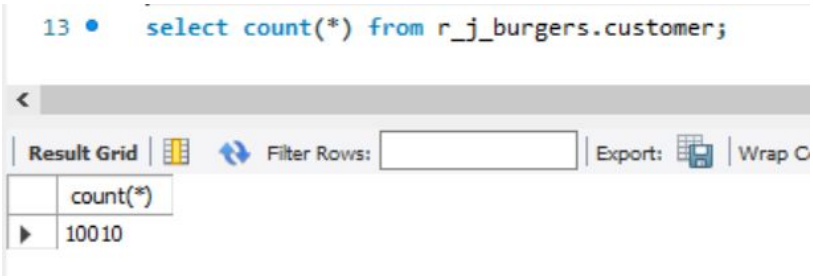
We created two indexes in the Customer table - for the CustomerPhone and CustomerLastName attributes. To run the next query the CustomerPhone index was used as it is more efficient:

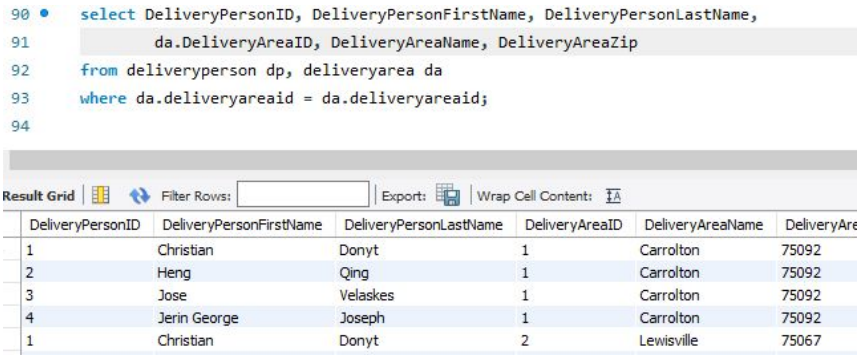
```
SELECT *
FROM r_j_burgers.customer
WHERE r_j_burgers.customer.CustomerPhone = "9172341717" AND
      r_j_burgers.customer.CustomerLastName = "Levy";
```

```
"key": "CustomerPhone",
"used_key_parts": [
  "CustomerPhone"
],
"key_length": "33",
"ref": [
  "const"
],
```

2) **in terms of accuracy:**

The results of the following queries prove accuracy in the database design and implementation.





As shown below, we maintained the same date format across the application to maintain accuracy

```
105 •  select * from payment;
```

Result Grid | Filter Rows: | Edit: | Exp

PaymentID	PaymentType	PaymentDate	PaymentTotalPaid	Ord
2	CC	2020-11-26 00:00:00	11.45	1
3	Credit	2020-11-27 00:00:00	23.76	12
4	Credit	2020-11-27 00:00:00	6.96	18

```
105 •  select * from r_j_burgers.order;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

OrderID	EmployeeID	DeliveryPersonID	CustomerID	OrderType	OrderTotalCost	DeliveryAddressID	OrderDateTime
1	1	1	1	Dine-In	12.45	1	2020-11-26 00:00:00
2	3	1	2	Dine-In	130.00	1	2020-11-26 00:00:00
3	1	1	1	Dine-In	130.00	1	2020-11-26 00:00:00

3) What challenges did you face in the development process?

- Lack of raw data - To test the performance of the indexes and the query plans, we did not have enough data to perform the test.
- Some technical issues during the design process:
- Database schema must have unique names for constraints
- The initial name for the ORDERS table was ORDER which is a keyword.
- Faced some access issues because the user id used did not have the grants to create tables.

4) How did you overcome those?

- Lack of raw data - We created an utility program to insert 10,000 rows into the customer table to setup the data for testing.
- To avoid the ORDER Table name clash with the keyword, we used the table name along with the schema as “r_j_burgers.ORDERS.
- Used documentations to resolve technical issues.

5) What are the limitations of the project?

- The application does not have an authentication mechanism, it can be included.
- The application does not allow the tip feature which is very important for American restaurants.
- The application is currently hosted locally on our computer, the application can be deployed in the cloud and be open to the internet, so that multiple users can use it.

6) Path to future work?

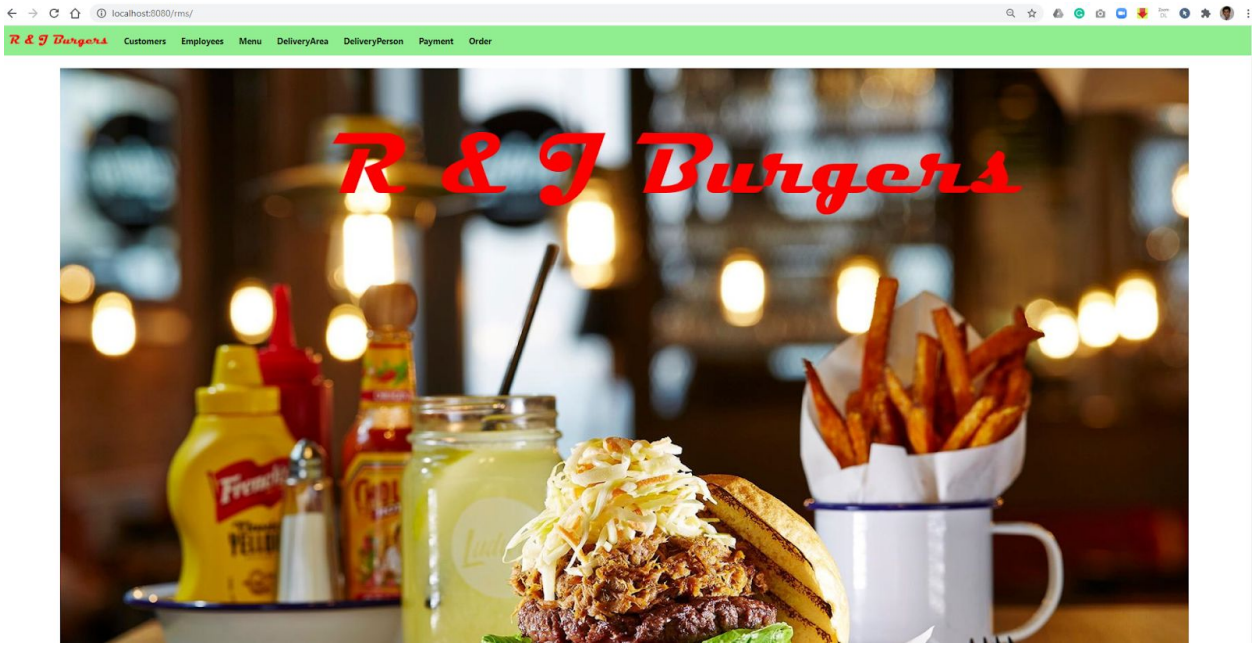
- Extend database with integrations to payment processors
- More customer data, more orders' records and hence optimize the application to handle higher volume.

References

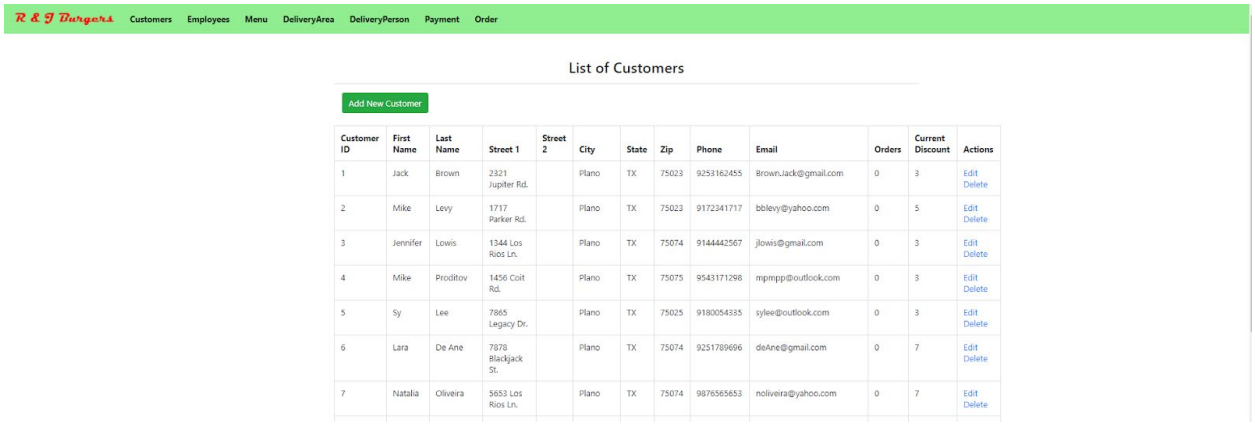
- Database System Concepts (Seventh Edition) by Avi Silberschatz, Henry F. Korth, S. Sudarshan;McGraw-Hill
- Database Systems: Design, Implementation, & Management (13th edition) by Carlos Coronel, Steven Morris
- MySQL Workbench - https://dev.mysql.com/doc/workbench/en/
- MySQL Indexes - https://dev.mysql.com/doc/refman/8.0/en/mysql-indexes.html

Appendix

Appendix A - UI Screenshots - Homepage

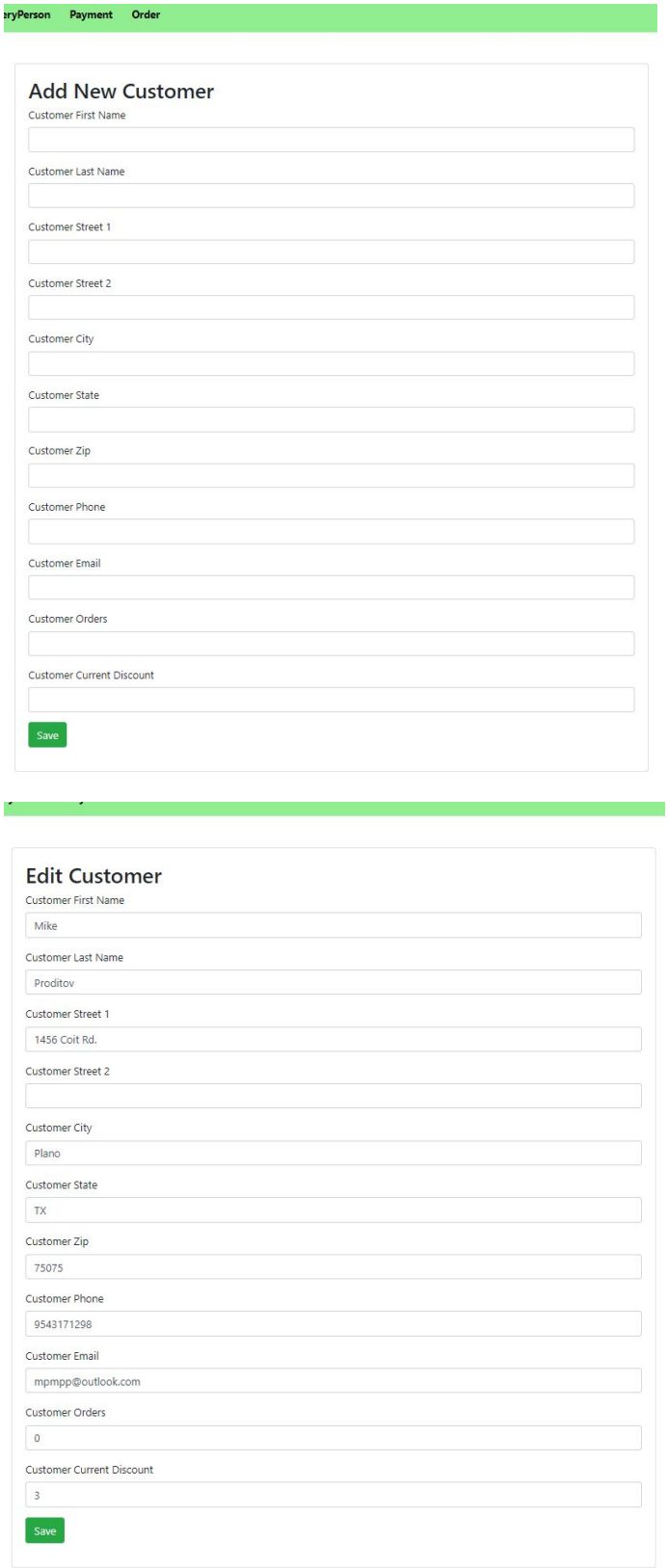


Appendix B - List of Customers Screen

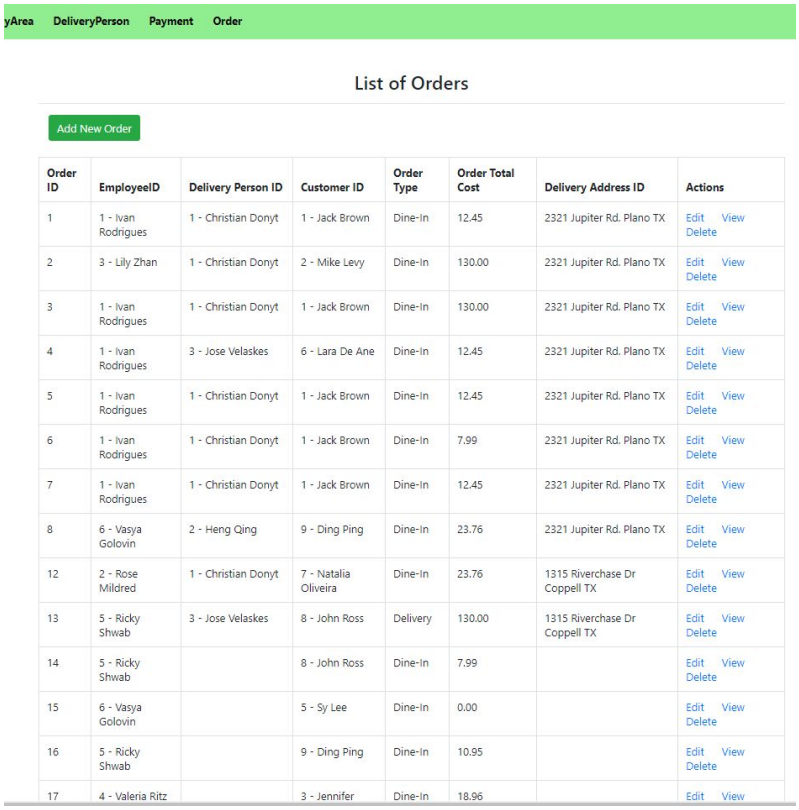


Customer ID	First Name	Last Name	Street 1	Street 2	City	State	Zip	Phone	Email	Orders	Current Discount	Actions
1	Jack	Brown	2321 Jupiter Rd.		Plano	TX	75023	9253162455	Brown.Jack@gmail.com	0	3	Edit Delete
2	Mike	Levy	1717 Parker Rd.		Plano	TX	75023	9172341717	bblevy@yahoo.com	0	5	Edit Delete
3	Jennifer	Lowis	1344 Los Rios Ln.		Plano	TX	75074	9144442567	jlowis@gmail.com	0	3	Edit Delete
4	Mike	Proditov	1456 Coit Rd.		Plano	TX	75075	9543171298	mpmpp@outlook.com	0	3	Edit Delete
5	Sy	Lee	7865 Legacy Dr.		Plano	TX	75025	9180054335	sylee@outlook.com	0	3	Edit Delete
6	Lara	De Ane	7878 Blackjack St.		Plano	TX	75074	9251789696	deAne@gmail.com	0	7	Edit Delete
7	Natalia	Oliveira	5653 Los Rios Ln.		Plano	TX	75074	9876565653	noliveira@yahoo.com	0	7	Edit Delete

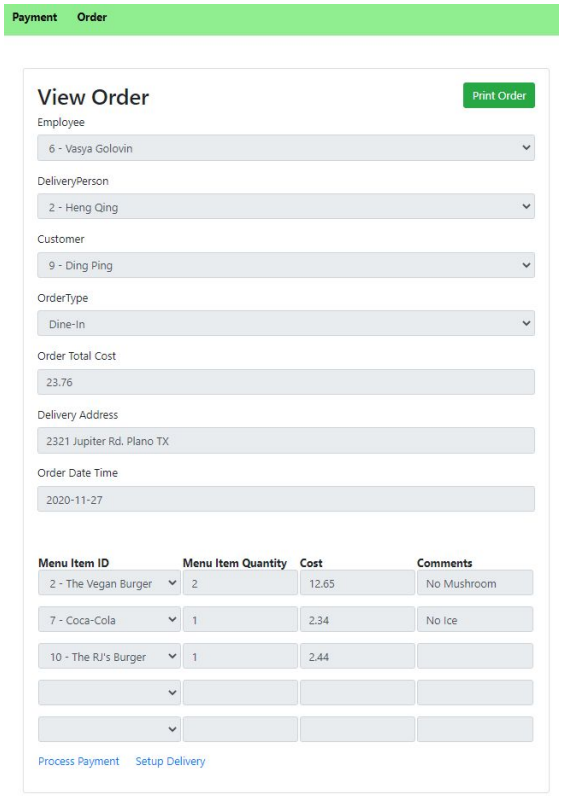
Appendix C - Add & Edit Customer



Appendix D - List of Orders & View Order



Order ID	EmployeeID	Delivery Person ID	Customer ID	Order Type	Order Total Cost	Delivery Address ID	Actions
1	1 - Ivan Rodrigues	1 - Christian Donyt	1 - Jack Brown	Dine-In	12.45	2321 Jupiter Rd. Plano TX	Edit View Delete
2	3 - Lily Zhan	1 - Christian Donyt	2 - Mike Levy	Dine-In	130.00	2321 Jupiter Rd. Plano TX	Edit View Delete
3	1 - Ivan Rodrigues	1 - Christian Donyt	1 - Jack Brown	Dine-In	130.00	2321 Jupiter Rd. Plano TX	Edit View Delete
4	1 - Ivan Rodrigues	3 - Jose Velaskes	6 - Lara De Ane	Dine-In	12.45	2321 Jupiter Rd. Plano TX	Edit View Delete
5	1 - Ivan Rodrigues	1 - Christian Donyt	1 - Jack Brown	Dine-In	12.45	2321 Jupiter Rd. Plano TX	Edit View Delete
6	1 - Ivan Rodrigues	1 - Christian Donyt	1 - Jack Brown	Dine-In	7.99	2321 Jupiter Rd. Plano TX	Edit View Delete
7	1 - Ivan Rodrigues	1 - Christian Donyt	1 - Jack Brown	Dine-In	12.45	2321 Jupiter Rd. Plano TX	Edit View Delete
8	6 - Vasya Golovin	2 - Heng Qing	9 - Ding Ping	Dine-In	23.76	2321 Jupiter Rd. Plano TX	Edit View Delete
12	2 - Rose Mildred	1 - Christian Donyt	7 - Natalia Oliveira	Dine-In	23.76	1315 Riverchase Dr Coppell TX	Edit View Delete
13	5 - Ricky Shwab	3 - Jose Velaskes	8 - John Ross	Delivery	130.00	1315 Riverchase Dr Coppell TX	Edit View Delete
14	5 - Ricky Shwab		8 - John Ross	Dine-In	7.99		Edit View Delete
15	6 - Vasya Golovin		5 - Sy Lee	Dine-In	0.00		Edit View Delete
16	5 - Ricky Shwab		9 - Ding Ping	Dine-In	10.95		Edit View Delete
17	4 - Valeria Ritz		3 - Jennifer	Dine-In	18.96		Edit View



Appendix E - Delivery Area and Payment