



**UNIVERSITY OF GHANA**  
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***Database Automation Techniques in Action: Case Studies  
from an Airport Filling Station with a Mall***

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## **Section 1: ABSTRACT**

This article explores the benefits of automation techniques in businesses, with a focus on two specific cases: the Airport Shell filling station and mini shopping mall in the filling station. Automation has become increasingly important in many industries, and its implementation can lead to reduced costs, improved customer satisfaction, increased revenue, and better decision-making. The article discusses the use of trigger functions in the filling station and mall, which are used to monitor inventory levels and automatically update sales records when products are sold. These techniques have improved the accuracy and efficiency of operations, resulting in better customer experiences and increased profitability. It also utilizes authentication methods (fingerprint) to sign in workers. The article concludes by highlighting the importance of embracing automation and new technologies to stay competitive in today's fast-paced world.

## **Section 2: INTRODUCTION**

Airport Shell is a large filling station located near Kotoka International Airport, which has gradually increased its activities over time. In order to serve its customers better, the management of the filling station has decided to automate all its activities. This project aims to automate various activities of the filling station such as sales, employee management, inventory management, and biometrics verification.

## **Section 3 : PROBLEM-SOLVING**

- Requirement Gathering: I will meet with the management team to discuss their requirements and understand the business processes currently in use. This will enable me to identify the tasks that can be automated.
- Data Analysis: I will analyze the data available in the filling station, such as customer information, sales records, and inventory details, to understand the relationships between them and how they can be used to improve the processes.
- Database Design: Based on the requirements and data analysis, I will design a suitable database schema that will ensure the efficient storage, retrieval, and manipulation of data.
- Development: With the database schema in place, I will proceed to develop the automated system that will incorporate all the business processes of the filling station. The system will be designed to be user-friendly, efficient and effective, and capable of handling high volumes of data.
- Testing: After the development of the automated system, I will test it thoroughly to ensure it meets all the requirements and functions as expected.
- Deployment: Once the testing phase is complete and the system is found to be working correctly, I will deploy it in the filling station, and ensure that all employees are adequately trained on how to use it.

- **Maintenance and Support:** To ensure the smooth running of the system, I will provide ongoing maintenance and support services to the filling station. This will include regular updates, bug fixes, and technical support.

#### **Section 4: Database Tables**

Several tables have been created for the filling station, each with its specific purpose. The tables are as follows:

**diesel\_tank:** This table contains information about the diesel tanks at the filling station. It has columns such as tankid, currentvolume, and daterecorded.

**petrol\_tank:** This table contains information about the petrol tanks at the filling station. It has columns such as tankid, currentvolume, and daterecorded.

**employee\_biometrics:** This table contains the biometric information of the employees of the filling station. It has columns such as employeeid and fingerprint.

**employee\_sign\_in:** This table contains information about the sign-in and sign-out times of the employees. It has columns such as sign\_in\_id, employee\_id, sign\_in\_time, sign\_out\_time, and fingerprint\_template\_text.

**mall\_products:** . Some filling station have a mini shopping mall. This table contains information about the products sold at the filling station mall. It has columns such as product\_id, product\_name, quantity, price, date\_added, date\_updated, and supplier.

**Fuel\_products:** This table contains information about the car-related products and accessories sold at the filling station. It has columns such as productid, productname, category, and price.

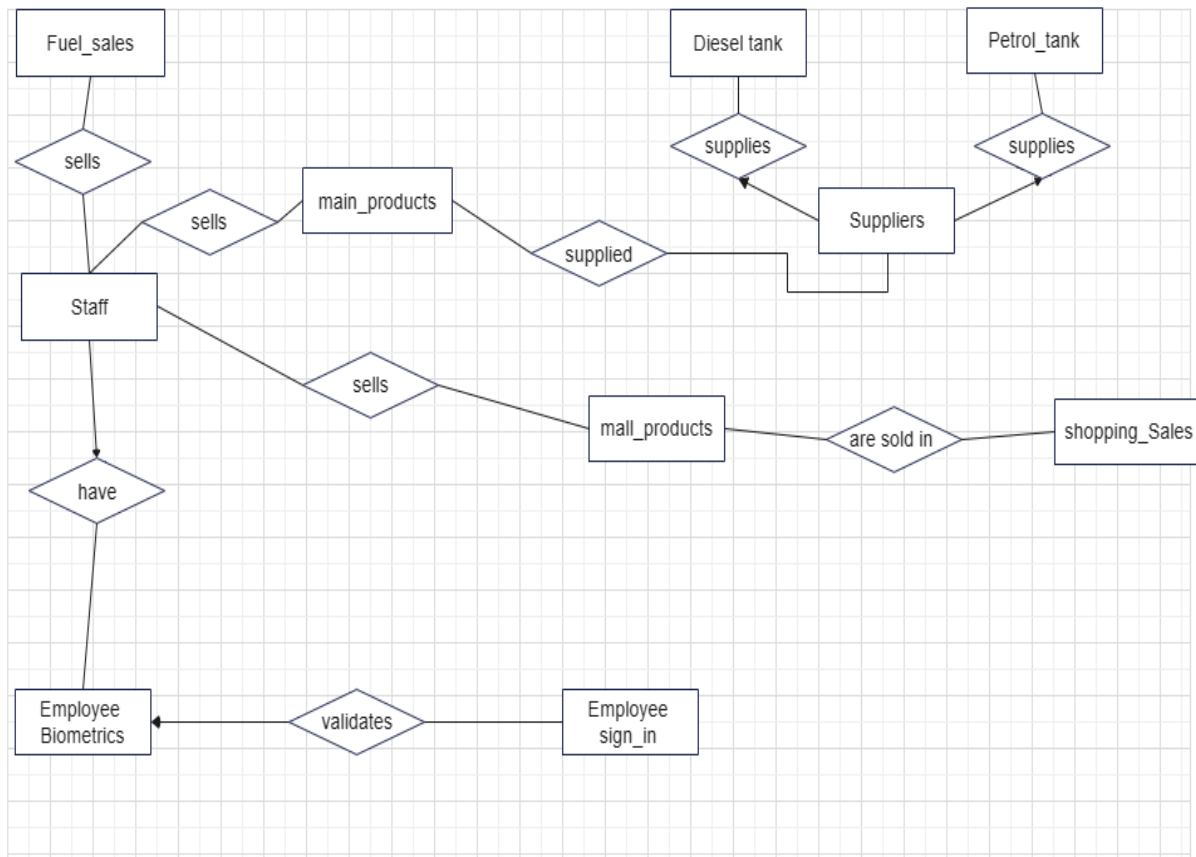
**Fuel\_sales:** This table contains information about the sales made at the filling station. It has columns such as salesid, salesdate, staffid, productid, unitprice, totalprice, and paymentmethod.

**staff:** This table contains information about the staff of the filling station. It has columns such as staffid, firstname, lastname, contactnumber, email, staff\_role, and salary.

**suppliers:** This table contains information about the suppliers of the filling station. It has columns such as supplierid, companyname, contactname, contactnumber, email, and address.

**Shopping\_sales:** This table contains information about the sales made at the mini-shopping mall. It has columns such as saleid, productid, price, quantity.

## Section 5: ER DIAGRAM



## Section 6: HOW DATA IS TRACKED AND AUTOMATED.

### EMPLOYEES

- All essential employee data is stored in the staff table. This table contains information about the staff of the filling station. It has columns such as staffid, firstname, lastname, contactnumber, email, staff\_role, and salary.
- It is essential to track when employee come and leave the workplace. This would help deal with punctuality and truancy. To achieve this, a employee-biometric table was created. This stroes the fingerprint detail of every employee.

- A trigger function was created so that employee\_login table wont be updated if the fingerprint being stored doesn't already exist in the employee\_biometric table. This ensures that no one can sign in for someone else.

	 <b>employeeid</b> [PK] integer 	<b>fingerprint</b> text 
1	1	AABBCCDDEEFF
2	2	112233445566
3	3	FFEEDDCCBBAA
4	4	001122334455
5	5	556677889900
6	6	CCBBAA998877
7	7	445566778899
8	8	113355779922
9	9	FFDDBBAA9988
10	10	0022446688AA
11	11	88AA66CC44DD
12	12	778899AA5566
13	13	BBCCDDEEFFAA
14	14	4455778899AA
15	15	FFDDEEBBCCAA

## EMPLOYEE SIGN-IN TABLE

	sign_in_id [PK] integer	employee_id integer	sign_in_time timestamp without time zone	sign_out_time timestamp without time zone	fingerprint_template_text text
1	1	1	2023-04-29 08:00:00	2023-04-29 17:00:00	AABBCCDDEEFF
2	2	2	2023-04-29 07:45:00	2023-04-29 16:30:00	112233445566
3	3	3	2023-04-29 08:15:00	2023-04-29 17:15:00	FFEEDDCCBBAA
4	4	4	2023-04-29 08:30:00	2023-04-29 17:30:00	001122334455
5	5	5	2023-04-29 07:30:00	2023-04-29 16:45:00	556677889900
6	6	6	2023-04-29 08:00:00	2023-04-29 16:30:00	CCBBAA998877
7	7	7	2023-04-29 08:15:00	2023-04-29 17:15:00	445566778899
8	8	8	2023-04-29 08:30:00	2023-04-29 17:30:00	113355779922
9	9	9	2023-04-29 07:45:00	2023-04-29 16:30:00	FFDDBBAA9988
10	10	10	2023-04-29 08:00:00	2023-04-29 17:00:00	0022446688AA
11	11	11	2023-04-29 08:15:00	2023-04-29 17:15:00	88AA66CC44DD
12	12	12	2023-04-29 08:30:00	2023-04-29 17:30:00	778899AA5566
13	13	13	2023-04-29 07:30:00	2023-04-29 16:45:00	BBCCDDEEFFAA
14	14	14	2023-04-29 08:00:00	2023-04-29 16:30:00	4455778899AA
15	15	15	2023-04-29 08:15:00	2023-04-29 17:15:00	FFDDEEBBCCAA

- In the scenario , where the fingerprint does not exist in the employee-biometrics table or an employee fingerprint does not match , an error messages is displayed. To achieve this a trigger function is used. This trigger function will ensure that a sign-in record is only created if the fingerprint provided matches the biometric data for the employee, as stored in the **employee\_biometrics** table. If the fingerprint doesn't match, the function will raise an exception and the sign-in record won't be inserted.

[Query Editor](#)
[Query History](#)

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186  
187  
188  
189  
190  
191 **INSERT INTO** employee\_sign\_in (employee\_id, sign\_in\_time, sign\_out\_time, fingerprint\_template\_text)  
192 **VALUES** (7, NOW(), NULL, '\x0123456789ABCDEF0123456789ABCDEF');  
193  
194  
195

---

[Data Output](#)
[Explain](#)
[Messages](#)
[Notifications](#)

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ERROR: Fingerprint does not belong to this employee  
CONTEXT: PL/pgSQL function validate\_employee\_fingerprint() line 9 at RAISE  
SQL state: P0001

## TANKS

- The Airport Shell filling station has four tanks, two for petrol and two for diesel. The current volume of each tank is recorded daily, and the volume decreases over time as the fuel is dispensed to customers. When a tank's volume drops below 50Kilo litres, a notification is sent to the manager to refill the tank. To achieve this, an automation technique using a trigger function is implemented.
- The trigger function is set up to check the currentvolume column of the petrol\_tank table whenever a new row is inserted or an existing row is updated. If the currentvolume value drops below 50kl, the trigger function will send a notification to the manager using the pg\_notify function. This notification serves as an alert that the petrol or diesel tank needs to be refilled to avoid running out of fuel and inconveniencing customers.
- Overall, this automation technique ensures that the filling station operates smoothly and efficiently by proactively monitoring fuel levels and notifying the manager when action is needed.

	id [PK] integer	tankid integer	currentvolume numeric (10,2)	daterecorded date
1	1	1008779	1200.50	2023-04-01
2	2	1008780	1350.75	2023-04-01
3	3	1008779	1140.25	2023-04-02
4	4	1008780	1295.00	2023-04-02
5	5	1008779	1085.75	2023-04-03
6	6	1008780	1245.50	2023-04-03
7	7	1008779	1027.25	2023-04-04
8	8	1008780	1175.00	2023-04-04
9	9	1008779	973.75	2023-04-05
10	10	1008780	1100.50	2023-04-05
11	11	1008779	919.25	2023-04-06
12	12	1008780	1025.00	2023-04-06
13	13	1008779	865.75	2023-04-07
14	14	1008780	950.50	2023-04-07
15	15	1008779	802.25	2023-04-08

Diesel Tank Table

	id [PK] integer	tankid integer	currentvolume numeric (10,2)	daterecorded date
1	1	1008779	100.25	2022-04-01
2	2	1008780	110.80	2022-04-01
3	3	1008779	97.76	2022-04-02
4	4	1008780	105.50	2022-04-02
5	5	1008779	93.50	2022-04-03
6	6	1008780	102.45	2022-04-03
7	7	1008779	90.25	2022-04-04
8	8	1008780	99.20	2022-04-04
9	9	1008779	87.50	2022-04-05
10	10	1008780	96.70	2022-04-05
11	11	1008779	85.05	2022-04-06
12	12	1008780	94.30	2022-04-06
13	13	1008779	82.90	2022-04-07
14	14	1008780	92.00	2022-04-07
15	15	1008779	80.55	2022-04-08

Petrol Tank table



## NOTIFCATION TO MANAGER

Query Editor

Query History

100

101

102

103

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--testing trigger function

INSERT INTO petrol\_tank (tankid, currentvolume, daterecorded)

VALUES (1008779, 15.35, '2023-05-7');

Data Output

Explain















Messages

Notifications

Recorded time	Event	Process ID	Payload
2023-04-29 19:17:13.105308	fuel_level_low	20524	Petrol fuel level is low, please order more fuel.
2023-04-29 19:17:51.116492	fuel_level_low	20524	Petrol fuel level is low, please order more fuel.
2023-04-29 22:24:27.913055	fuel_level_low	20524	Petrol fuel level is low, please order more fuel.
2023-04-29 22:27:28.610116	fuel_level_low	20524	Petrol fuel level is low, please order more fuel.
2023-04-29 22:27:41.954970	fuel_level_low	20524	Petrol fuel level is low, please order more fuel.

Notification to alert manager of low fuel level.

## FUEL\_SALES TABLE

	 salesid [PK] integer 	 salesdate date 	 staffid integer 	 productid integer 	 unitprice numeric (10,2) 	 totalprice numeric (10,2) 	 paymentmethod character varying (50) 
1	51	2023-04-01	5	10	5.50	55.00	Cash
2	52	2023-04-01	2	9	8.25	74.25	Credit Card
3	53	2023-04-02	7	1	9.50	95.00	Cash
4	54	2023-04-02	3	3	12.75	255.00	Cash
5	55	2023-04-03	4	8	7.50	112.50	Credit Card
6	56	2023-04-03	6	2	3.75	37.50	Cash
7	57	2023-04-04	1	5	11.00	110.00	Credit Card
8	58	2023-04-04	9	6	6.00	72.00	Cash
9	59	2023-04-05	8	7	5.25	78.75	Credit Card
10	60	2023-04-05	2	3	13.50	270.00	Cash
11	61	2023-04-06	3	4	8.00	88.00	Cash
12	62	2023-04-06	4	10	6.25	62.50	Credit Card
13	63	2023-04-07	6	2	3.25	32.50	Cash
14	64	2023-04-07	5	1	10.75	107.50	Credit Card
15	65	2023-04-08	7	9	7.00	63.00	Cash
16	66	2023-04-08	1	8	5.50	82.50	Credit Card
17	67	2023-04-09	2	5	11.50	115.00	Cash
18	68	2023-04-09	8	4	8.25	99.00	Credit Card
19	69	2023-04-10	3	3	12.50	250.00	Cash
20	70	2023-04-10	6	6	5.75	69.00	Credit Card
21	71	2023-04-11	4	7	6.75	101.25	Cash
22	72	2023-04-11	9	1	9.25	92.50	Credit Card
23	73	2023-04-12	5	2	4.50	45.00	Cash
24	74	2023-04-12	1	10	5.75	57.50	Credit Card
25	75	2023-04-13	7	9	7.50	67.50	Cash
26	76	2022-02-03	6	2	8.50	34.00	cash

### MALL\_PRODUCT AND SHOPPING\_SALES TABLE (TRIGGER FUNCTION)

- The Mall\_Product table contains information about every product available in the mall, including the quantity in stock. When a customer purchases a product from a shop in the mall, the sale is recorded in the Shopping\_Sales table. This sale also results in a corresponding reduction in the quantity of the product left in the shop.
- To ensure that the reduction in quantity is reflected in the Shopping\_Sales table, a trigger function is implemented. This trigger function automatically decreases the quantity of the purchased product in the Mall\_Product table by the number of items bought by the customer. As a result, the quantity of the product in the shop is updated, and the Shopping\_Sales table accurately reflects the products sold.
- This automation technique ensures that the mall's inventory management is accurate and up-to-date. It also enables the mall to make data-driven decisions, such as restocking popular items, and provides valuable insights into the mall's sales performance.

Data Output		Explain	Messages	Notifications			
	product_id [PK] integer	product_name character varying (50)	quantity integer	price numeric (10,2)	date_added date	date_updated date	supplier character varying (50)
1	1	Coca-Cola	100	1.99	2023-04-29	2023-04-29	Coca-Cola Company
2	2	Fanta	77	1.99	2023-04-29	2023-04-29	Coca-Cola Company
3	3	Sprite	120	1.99	2023-04-29	2023-04-29	Coca-Cola Company
4	4	Red Bull	50	2.99	2023-04-29	2023-04-29	Red Bull GmbH
5	5	Monster Energy	70	2.99	2023-04-29	2023-04-29	Monster Beverage Corporation
6	6	Nestle Pure Life Water	150	0.99	2023-04-29	2023-04-29	Nestle Waters
7	7	Pepsi	90	1.99	2023-04-29	2023-04-29	PepsiCo

Before Sales, the quantity of Fanta was 77.

After buying 3 fantas

16	16	2	3	6.00	2023-04-28	John Doe	Cash
17	17	2	3	6.00	2023-04-28	John Doe	Cash

The quantity of fantas in the mall\_products has reduced automatically by 3.

	product_id [PK] integer	product_name character varying (50)	quantity integer	price numeric (10,2)	date_added date	date_updated date	supplier character varying (50)
1	1	Coca-Cola	100	1.99	2023-04-29	2023-04-29	Coca-Cola Company
2	2	Fanta	74	1.99	2023-04-29	2023-04-29	Coca-Cola Company
3	3	Sprite	120	1.99	2023-04-29	2023-04-29	Coca-Cola Company
4	4	Red Bull	50	2.99	2023-04-29	2023-04-29	Red Bull GmbH
5	5	Monster Energy	70	2.99	2023-04-29	2023-04-29	Monster Beverage Corporation
6	6	Nestle Pure Life Water	150	0.99	2023-04-29	2023-04-29	Nestle Waters
7	7	Pepsi	90	1.99	2023-04-29	2023-04-29	PepsiCo

## **Section 7: CONCLUSION**

In conclusion, automation is becoming increasingly critical in many industries and businesses. With the rise of new technologies, it is essential to automate repetitive and time-consuming tasks to improve efficiency, productivity, and accuracy. The implementation of automation techniques in businesses can lead to significant benefits, including reduced costs, improved customer satisfaction, increased revenue, and better decision-making.

As a database consultant, understanding the specific needs of a business is critical in implementing automation effectively. It requires a systematic approach, including requirement gathering, data analysis, database design, development, testing, deployment, and ongoing maintenance and support. In the case of the Airport Shell filling station and mall, implementing automation techniques has improved the accuracy and efficiency of their operations, resulting in better customer experiences and increased profitability.

Businesses that embrace automation and new technologies are better positioned to stay competitive in today's fast-paced world. The benefits of automation are clear, and it is essential for businesses to consider how they can incorporate these techniques into their operations to achieve long-term success.