Data driven decision making driving towards the vision of shopping experience with minimal or no human interaction

Ishan H Mistry
Student of Information and Communication Technology
Pandit Deendayal Petroleum University, Raisan - Gandhinagar, Gujarat,India
Email : mistryishan25@gmail.com; mistryishan@ymail.com

Khush Joshi
Student of Information and Communication Technology
Pandit Deendayal Petroleum University, Raisan - Gandhinagar, Gujarat,India
Email : khushvipin73@gmail.com

Alister Rodrigues
Student of Information and Communication Technology
Pandit Deendayal Petroleum University, Raisan - Gandhinagar, Gujarat,India
Email : alister.rodrigs@gmail.com

Nishant Doshi
Professor in Dept. of Computer Engineering at
Pandit Deendayal Petroleum University ,Raisan - Gandhinagar, Gujarat,India
Email : Nishant.Doshi@sot.pdpu.ac.in

Pandit Deendayal Petroleum university

Abstract

An attempt to create a data model that could accurately represent the instances of the real time data that flows into a plain regular grocery shop into a database model that can be automated in the later stages, such that less and less human intervention prevails, even when it comes to data manipulation. Incorporating the sensor fusion and RFID architecture in order to identify all the items and the customers, and also the combined effect i.e items carried/ purchased by the customer.

Keywords:

No Human Intervention, IoT based smart shopping, Out of stock scanning/inventory counting, Sensor fusion, Relational Database model, Virtual warehouse,Intelligent tracking

Data-driven decision-making driving towards the vision of shopping experience with minimal human intervention.

Introduction

One of the constants that prevail in almost every city and town and even in the rural suburbs in India is the *retail shops* or *market shops* or *specialist stores*, *kiranas* which have all been categorized under the name “**Unorganized retail**”. The problem many of the current grocery stores suffer from the problem of poor logistics and our project tries to tackle the same by making adjustments in the database so as to fire queries that can directly supply the user with the relevant information. This paper gives some early insights into the underlying data model for **future applications** based on similar technologies.

Unique features:

1. We have tried to implicitly add and promote the very idea of using eco-friendly by allowing the users of our system to bring their own utensils, say glassware, like glass bottles to carry some items like oil or cereal (as we try and promote the local vendors, most of the items might be in a specific packaging).

2. We have also created a series of queries for the database that can be put into modules later and could be accessed easily through **wrapper**. These queries provide valuable information that could be inferred from the dummy data that has been fed into our model for experimental purposes.

3. An alternative approach that is a comparatively lesser expensive approach to verifying the status of objects that are picked by the

customers to the more computationally expensive option of computer vision.

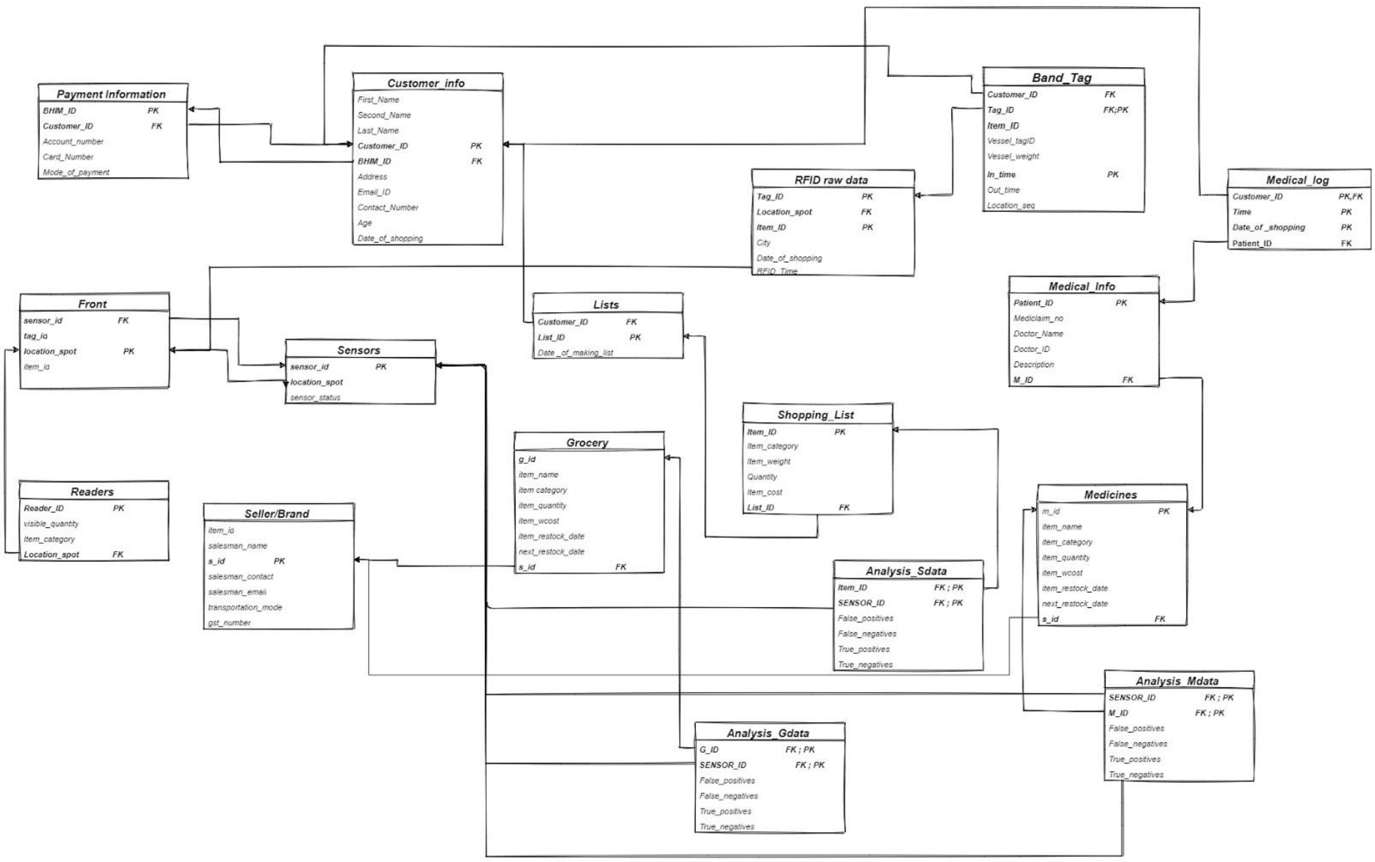
4. Personalization is a factor that has become the driving force for many of the applications that surround us and this approach tries to make the shopping experience more personalized and ultra-convenient.

Proposed Work

Relational Diagram: The Relational or the Schema diagram is the skeleton structure of the entire database or we can say it is a logical representation of the database. It defines how the data is organised in the tables and how the tables are associated with each other with foreign keys. It also formulates the constraints that are to be applied on the data. It defines tables, views and integrity constraints.

All of our tables in the relational diagram can be categorised mainly in 3 categories

1.) Sensors Related Information (sensors, front, readers, band_tag and RFID_raw_data)
2.) Customer Related Information (customer_information, payment_information, list, shopping list, medical log and medical_information)
3.) Inventory Related Information (Seller, Grocery, Medicines, analysis_Gdata, analysis_Mdata, analysis_Sdata)

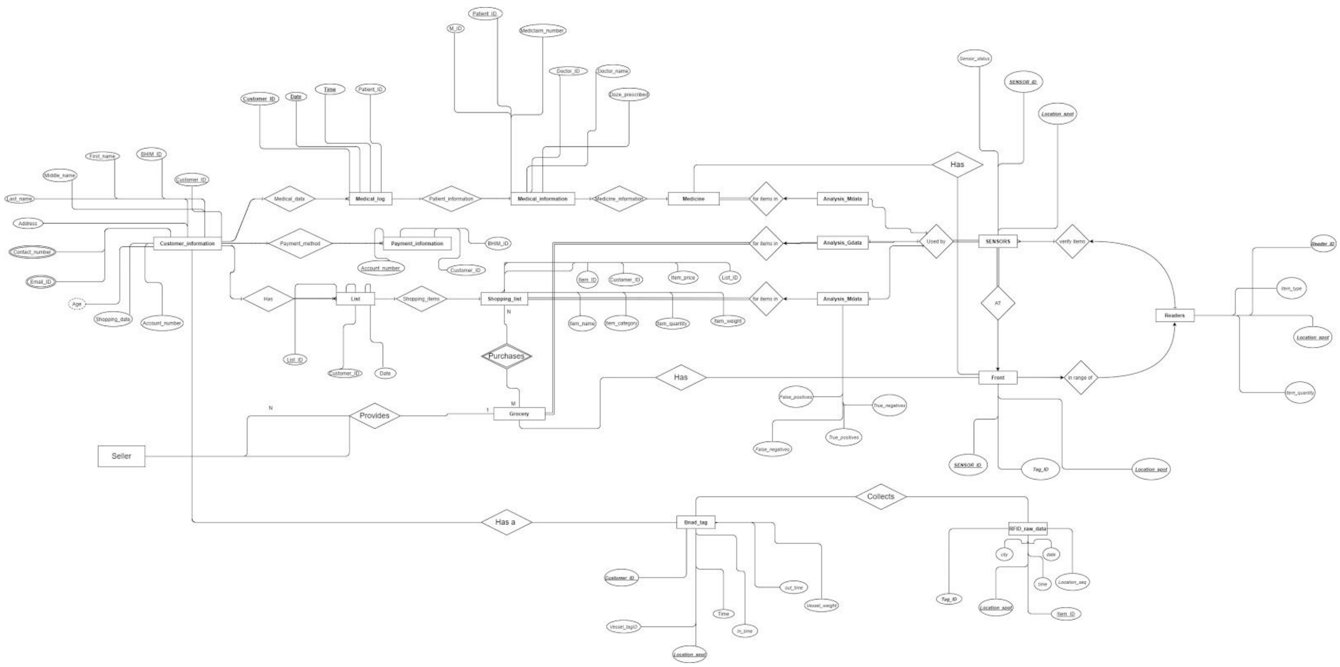


Keeping in mind the unique features the eco-friendliness feature is visible in the band_tag table where we have vessel_tagID and vessel_weight. So the vessel that is brought by the customer will be given a tag and that will be weighed and we are going to use triggers to update the weight by the difference of the empty vessel to the filled vessel.

Secondly, we are not only relying on the RFID architecture but we are also trying to incorporate sensors to verify the things

Entity Relationship Diagram: The Entity Relationship diagram describes how the different entities in the database are connected with each other or we can say it defines the relationship among them. It also gives us the idea of how we can fetch the data from these connected entities. ER model can be further divided in the three sub parts:

1. Based on the relations (Identifying Relations and Non Identifying Relations)
2. ER model has a variety of attributes (Key Attributes, Normal Attributes, Derived Attributes, Multivalued Attributes.)
3. Also the ER model follows the cardinality relationship (One to One, One to Many, Many to one, Many to Many.)



Experimental Analysis

Working through our database model we made a lot of queries and other function that might test the system but as the system was not put in practice hence we couldn't collect the real time analysis data of any sort and hence we rely on the literature survey that we have performed.The following section guides one through the all the decisions that we made and also some of the most relevant queries that we have performed.

TABLE 1 – RFID versus Bar Code Technology

Bar Codes	RFID Tags
• Bar Codes require line of sight to be read	• RFID tags can be read or updated without line of sight
• Bar Codes can only be read individually	• Multiple RFID tags can be read simultaneously
• Bar Codes cannot be read if they become dirty or damaged	• RFID tags are able to cope with harsh and dirty environments
• Bar Codes must be visible to be logged	• RFID tags are ultra thin, and they can be read even when concealed within an item
• Bar Codes can only identify the type of item	• RFID tags can identify a specific item
• Bar Code information cannot be updated	• Electronic information can be over-written repeatedly on RFID tags
• Bar Codes must be manually tracked for item identification, making human error an issue	• RFID tags can be automatically tracked, eliminating human error

A very convincing and summarised way of the exact reasons we found the usage of barcode verification as not a go-to solution always when it comes to correct measurement and hence [16] validates our notion of using sensor fusion as the underlying verification mechanism.

Table 1: RFID Reading vs Barcode Reading

Group of Items	Number of Items	Reading Time using RFID (Minutes)	Reading Time using Barcode (Minutes)
1	50	1,51	3,55
2	45	1,22	3,21
3	60	1,62	3,82
4	69	1,69	3,89
5	55	1,53	3,68
6	78	1,71	4,15
7	85	1,82	4,62
8	68	1,68	3,81
9	81	1,8	4,32
10	67	1,67	3,85
TOTAL	658	16,25	38,9

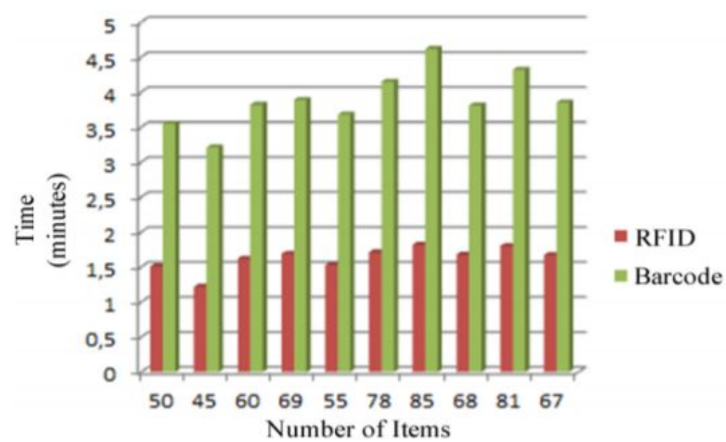


Figure 12: Process based on RFID vs Process based on Barcode

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Along the similar lines by the practical analysis conducted in the paper [9], the usage of barcode is clearly an inefficient way of determining the system and also in a way it quite restricted in use(as previously explained by the table)

1. **List sensor_id and location spot of the sensors that have the same location.**

   SELECT A.sensor_ID AS sensorid1, B.sensor_ID AS sensorid2, A.location_spot
   FROM sensors A, sensors B
   WHERE A.sensor_id <> B.sensor_id
   AND A.location_spot = B.location_spot
   ORDER BY A.location_spot;

sensorid1	sensorid2	location_spot
BUT000	BUT240	H5
BUT000	BUT419	H5
BUT000	BUT592	H5
BUT000	BUT703	H5
BUT001	BUT060	C8
BUT001	BUT100	C8
BUT001	BUT155	C8
BUT006	BUT160	G5
BUT006	BUT688	G5
BUT006	BUT790	G5
BUT006	BUT793	G5
BUT007	BUT104	B9
BUT007	BUT415	B9
BUT007	BUT785	B9
BUT007	BUT963	B9

2. List all the medicines and their counts(as actual purchases) that were truly verified as "purchased" from the analysis_mdata table.

   SELECT medicines.item_name, COUNT(analysis_mdata.true_positives)
   AS actual_purchases
   FROM analysis_mdata
   INNER JOIN medicines **ON** analysis_mdata.m_id = medicines.m_id
   WHERE item_category != 'paracetamol' OR item_category != 'pain killer'
   GROUP BY item_category;

item_name	actual_purchases
Chelidonium Curcuma	38
OxyContin	32
NIACIN	34
SunZone Family SPF 45	24
Lac Hydrin	38
Lyrica	26

3. Find the customer_id, first_name, address and date_of_shopping of all the customers who bought the item grocery between the dates 2019-01-1 and 2019-12-31 and their mode of payment was through Net Banking.

   SELECT customer_id, first_name,date_of_shopping, address, mode_of_payment
   from dbms.customer_information
   natural join dbms.lists
   natural join dbms.shopping_lists
   natural join dbms.payment_information
   where item_category="grocery" **and** date_of_shopping **between** "2019-01-1"**and**"2019-12-31" **and** mode_of_payment="Net Banking";

customer_id	first_name	date_of_shopping	address	mode_of_payment
95	Allis	2019-11-19	Kolape	Net Banking
91	Flynn	2019-03-11	Livorno	Net Banking
91	Flynn	2019-03-11	Livorno	Net Banking
103	Bernette	2019-12-22	Matur	Net Banking
111	Nola	2019-08-15	Armavir	Net Banking
93	Ruperto	2019-05-28	Laguna Salada	Net Banking
102	Wilfrid	2019-09-22	Prabuty	Net Banking
77	Janela	2019-03-09	Sīrīs	Net Banking
77	Janela	2019-03-09	Sīrīs	Net Banking
62	Liam	2019-12-11	Pokrovka	Net Banking
56	Ammamaria	2019-12-16	Buenavista	Net Banking
99	Martelle	2019-09-03	Jiaqu	Net Banking
131	Marlowe	2019-11-19	Mitzpe Ramon	Net Banking
73	Kalie	2019-08-25	Yong'an	Net Banking

4. List the total number of orders placed already for items in grocery which have a quantity less than 100.

   SELECT (grocery.item_name), **COUNT**(grocery.item_restock_date) **AS** NumberOfOrdersPlaced
   FROM analysis_gdata
   INNER JOIN grocery **ON** analysis_gdata.g_id = grocery.g_id
   GROUP BY grocery.g_id
   HAVING COUNT(grocery.item_quantity) <100;

	item_name	NumberOfOrdersPlaced
	Condensed	1
	Oyster	1
	Blackcurrant	1
	Romaine, Heart	1
	Diet	1
	Wheat Baguette	1
	Mix	1
	Franks Pineapple	1
	Sprinkles, Assorted	1
	15l White, With Handle	1
	Chocolate Chip	1
	Fillet	1
	Black Cherry, 591 Ml	1
	Clear 32 Oz	1
	Breakfast	1
	Padano	1
	Sweetbread	1

5.List sensor_id and location spot of the sensors that have the same location

```
SELECT A.sensor_id AS sensorid1, B.Sensor_id AS sensorid2, A.location_spot
FROM sensors A, sensors B
WHERE A.sensor_id <> B.sensor_id
AND A.location_spot = B.location_spot
ORDER BY A.sensor_id;
```

sensorid1	sensorid2	location_spot
BUT000	BUT240	H5
BUT000	BUT592	H5
BUT000	BUT703	H5
BUT000	BUT419	H5
BUT001	BUT100	C8
BUT001	BUT155	C8
BUT001	BUT060	C8
BUT006	BUT688	G5
BUT006	BUT160	G5
BUT006	BUT793	G5
BUT006	BUT790	G5
BUT007	BUT963	B9
BUT007	BUT104	B9
BUT007	BUT785	B9
BUT007	BUT415	B9
BUT012	BUT356	C6
BUT012	BUT948	C6

6.Info about customers without any home brought vessel.

SELECT first_name, last_name, Age
FROM Band_Tag A
RIGHT JOIN customer_information B
ON A.customer_id = B.customer_id
WHERE vessel_tag_id **IS NULL**;

first_name	last_name	Age
Tawsha	Mault	34
Max	Broad	55
Valencia	Alway	46
Hakim	Ghiotto	76
Babara	Folley	48
Etan	Berntsson	60
Mirabelle	Georgeou	31
Nellie	Birkin	27
Beatriz	Sinclaire	41
Ches	Petheridge	73
Petunia	MacKall	73
Mollie	Koppeck	69
Dougy	Revington	51
Andres	Pirson	61
Luelle	Kennea	28
Bobine	Waggitt	79

7. Find the customer_id, medicine_id and doctor_id of all the customers who purchased either Acetaminophen or Avobenzone

USE dbms;
SELECT customer_id, m_id, doctor_id and doze_prescribed
FROM medical_info **NATURAL JOIN** medical_log
NATURAL JOIN customer_indformation
WHERE doze_prescribed = ‘Acetaminophen’ **OR** doze_prescribed = ‘Avobenzone’;

customer_id	m_id	doctor_id	doze_prescribed
4	M4	12159	Avobenzone
10	M10	12930	Acetaminophen
42	M42	12250	Acetaminophen
47	M47	12988	Avobenzone
49	M49	12885	AVOBENZONE
66	M66	12117	Acetaminophen
77	M77	12386	ACETAMINOPHEN
92	M92	12710	Acetaminophen
97	M97	12012	Acetaminophen
101	M101	12393	Avobenzone

	Feature 1	Feature 2	Feature 3	Feature 4	Feature 5	Feature 6
[2]	Yes	No	No	No	No	No
[4]	Yes	Yes	No	No	No	Yes
[6]	Yes	Yes	No	No	No	No
[9]	Yes	Yes	No	No	No	Yes
[12]	Yes	Yes	Yes[B]	Yes	No	Yes

Legends:

Feature 1 - RFID based architecture
Feature 2 - Inventory management
Feature 3 -Verification mechanisms(Barcode - "B", Sensors - "S")
Feature 4 - Freedom of using custom vessels
Feature 5 - In-built Analysis information for future prediction
Feature 6 - No human input for data manipulation directly

Future scope/work

The whole database is currently to be hosted on-site but the remote management of the database on the cloud infrastructure is a possibility for the future to come.

With the current usage of the system going live we can once do all sorts of things including "regularly personalized recommendation" by using learning algorithms to capture the trends in your shopping styles and also to forecast the future trends.

Conclusion

We have basically tried to showcase a data model that could be then added to any other platform(website/app/custom implementation)

Outcome 1
The support in terms of a constant passive income for the local vegetable vendors

Outcome 2
Reducing human interaction essentially helps in times when having essentials is not easily accessible say in a pandemic

Outcome 3
As some of the queries displayed in the analysis section hint towards how we can easily have queries set up to make small decisions based on the data

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