Modularised Framework For Mobile Shopping Assistance System

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Abstract— **Shopping assistance systems make a great impact on shopping malls revenue, so considering that in mind, Majority of shopping malls has adopted a shopping assistance system that suites to their malls architecture. We a proposing a shopping assistance system framework that can be implemented to any architecture (weather it is based in NFC, QR Code, Barcode, Network or a combination of all). The framework also capable of capturing the new and upcoming mobile technologies.**

Keywords— NFC; Shopping assistance system; Mobile shopping; Modular shopping; Secure payment; Mobile shopping Assistance;

I. INTRODUCTION

Shopping malls are always in a race to find a better way to manage their inventory, customer data and payments. So, in majority of cases, shopping malls prefer a shopping assistance system designed to match their stores architecture. Walmart is one of the biggest player in household shopping and is constantly trying to improve shopping experience. In order to achieve this goal, they used smart cart, digital assistance and robotic assistance systems. All these methods come under a same domain known as shopping assistance system. Now as the mobile industry is growing, malls found another medium to connect with customers. Using mobile applications can provide rich and dynamic content line new arrivals and deals.

II. LITERATURE SURVEY

There are many systems designed for the sake of a good shopping experience for the customers but the usually revolve around a certain technology without considering the architecture of the store or feasibility to apply that technology to the store.

The technologies they came to existence as a mobile technologies are:

1. Barcode
2. QR Code
3. Wireless Network
4. NFC
5. Image Processing
6. RF-Id

Previously made systems for shopping assistance innovate the use of technologies to be used in a creative way to create a user friendly and convenient methods for list management or payment [2] [3] [5] [6].

All these methods are scattered and becomes unusable if store doesn't support that kind of architecture.

And at some time these systems fail to deliver the perfect experience, if some hackers find a loop hole in the system then application fails completely and store has to redesign its shopping assistance system again [4] [7]. In such scenarios a modular system can help in a great extent.

An ideal shopping assistance system mainly consist of 7 necessary modules and they are built to consume some known architecture of the store for which it is designed for. If the store decides to move to a newer technology that is more convenient and suitable to the store, then the store has to create a new shopping assistance system for the partially new store. And this take more time and money. So, we need such a system which can withstand these changes in technology, a modular shopping assistance framework that can toggle the technology being used in the module without effecting the system.

Modules consist in a shopping assistance system are:

1. Shopping List Management
2. Orientation
3. Product Information
4. Shopping Basket Management
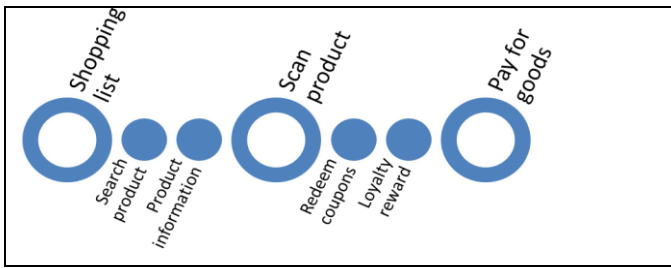5. Coupon Redemption
6. Customer Loyalty Reword
7. Payment

Fig 1 Shopping Process Overview

III. MODULES, TECHNOLOGIES AND METHODS

A shopping assistance system is a modular and technology centric.

A. Technologies

- **Barcode:** A barcode is an optical machine-readable representation of data relating to the object to which it is attached. Originally barcodes systematically represented data by varying the widths and spacing's of parallel lines, and may be referred to as linear or one-dimensional (1D). They are found on every product you purchase, the encoding used there is UPCA or UPCE.

- **QR Code:** QR code (abbreviated from Quick Response Code) is the trademark for a type of matrix barcode (or two-dimensional barcode) first designed for the automotive industry in Japan. A barcode is a machine-readable optical label that contains information about the item to which it is attached. A QR code uses four standardized encoding modes (numeric, alphanumeric, byte / binary, and kanji) to efficiently store data; extensions may also be used. The QR Code system became popular outside the automotive industry due to its fast readability and greater storage capacity compared to standard UPC barcodes. Applications include product tracking, item identification, time tracking, document management, and general marketing. QR Codes are getting popular lately as a popular means for data transfer on mobile devices. Companies like PayPal are using it for direct payment to users.

- **Wireless Network:** Wireless network is the primary means of exchanging data for a mobile device. Here we can use a cellular network or a local Wi-Fi connection for the store.

- **NFC:** Near field communication (NFC) is a set of ideas and technology that enables smartphones and other devices to establish radio communication with each other by touching the devices together or bringing them into proximity to a distance of typically 10 cm (3.9 in) or less. NFC is popular in cloud connected devices.

- **Image Processing:** Image processing is an all in one solution for identifying products in 2 modules: Information retrieval and shopping basket management. But due to its high cost of time and hardware requirement to process minimizes its advantages.

- **RF-Id:** Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. RFID is not available in smartphones but they are easily accessible by other smaller mobile devices. It can have a great advantage in shopping basket management as it can scan the whole basket at once.

B. Modules

- **Shopping list management:** Shopping list management is the initial stage of shopping process. In this stage user create a list of products that user wants to purchase. A good shopping assistance should give suggestions or recommendation based on user preferences and history of user purchases. Use new arrivals and offers to attract user for buying more products.

- **Orientation:** Orientation involves finding the desired product in a store. Finding a product in a shopping mall can be time consuming and minimizing this can help users to get it done quickly.

- **Product Information:** This module show more information to user for a product. Self-scanning is one of the keen aspect of a shopping assistance.

- **Shopping Basket Management:** It is the stage where shopkeeper scans your basket and prepares the bill.

- **Coupon Redemption:** User apply coupon codes to the products they purchase, often used for sale and stock clearance period.

- **Customer Loyalty Reward:** This part of the shopping process involves giving extended discounts and points for their loyalty to the store.

- **Payment:** It is the last step in a shopping process. Customer pays for the goods they purchase.

C. Relations

The technologies and modules are related with each other. The list of technology that can manage a module completely or partially.

1. Shopping list management:
   - NFC
   - QR-code
   - Barcode
   - Wireless Network
2. Orientation:
   - Wireless Network
3. Product information:
   - NFC
   - QR-code
   - Barcode
   - Wireless Network
   - Image Recognition
4. Shopping basket management:
   - NFC
   - QR-code

- Barcode
5. Coupon redemption:
    - NFC
    - QR-code
    - Barcode
    - Wireless Network
6. Customer loyalty reward:
    - NFC
    - QR-code
    - Barcode
    - Wireless Network
7. Payment:
    - NFC
    - QR-code
    - Barcode
    - Wireless Network

And many more combinations can be made upon the changes in the technologies and methods that step in future.

D. Methods

Shopping assistance system can use several methods that are built from years.

1. Shopping List Management:
    - Manually add an item
    - Scan barcode/QR-Code
    - Add from network
2. Orientation:
    - Mapping the items in the list on store (GPS don't work in such small scale).
3. Product Information:
    - Self-Scanning with barcode, QR-Code or NFC
    - Image recognition as reverse image search in database.
4. Shopping Basket Management:
    - Scan products one by one using barcode, QR-Code or NFC.
    - Scan the whole basket either using image recognition or RF-ID tag scanning.
5. Coupon Redemption:
    - Scan coupon code by barcode, QR-Code or NFC.
    - Manually apply coupon to list.
6. Loyalty Reward
    - Give added discount based on customer's loyalty level.
    - Give loyalty points that customer can use to purchase products.
    - Give products with a coupon that is available in those loyalty points.

7. Payment
    - Online Banking (Transfer money online).
    - Either of them (the shopkeeper or customer) should pass his banking to other.
        - i. Case 1: customer should pass his banking information to shopkeepers system for payment.
        - ii. Case 2: shopkeeper should pass his banking information to customer's phone for payment.
    - No one knows other's banking info: In this method,
        - i. Customer sends a payment request to the server with amount and list.
        - ii. Server responses with a random id (Payment Id) which is pre encrypted and saves the balance and list with the payment id, to the database.
        - iii. Customer sends that encrypted id to shopkeeper's system (By any mean).
        - iv. Shopkeeper's system decrypts the received encrypted id and sends it to bank server.
        - v. Now the server checks whether the requested payment id is matched with the existing one in the database.
        - vi. If match completed, then the payment is made and payment id is removed from database.

Some methods can be better the others and some methods in combination with other technologies may work even better.

Some even better methods are to be introduced in near future that work more efficiently with newer devices and technologies.

IV. FRAMEWORK

As the framework is mainly designed to work mobile devices. The devices can be low powered with low RAM and memory, So, It is important for the framework to be light-weighted and fast.

So complicated things like bigger encryption algorithms and image recognition may not work in all devices.

A. Algorithms

Algorithms used in this framework may be not well suited in all the cases and senarios.

1. Orientation: For finding the shortest path for the customer in the store can be seen as travelling salesmen problem, and has to be solved in that approach. Solving travelling salesmen problem with brute force method can take more resources the other but it makes sure that we get the best answer and in a scenario where not much points involved (number of items in the list), it can do a great job. The below algorithm illustrate the brute force method for travelling salesmen problem (Or travelling customer problem).

   - We first map all the item locations as latitude and longitude co-ordinates (below Image) and save co-ordinates with location id in the database.
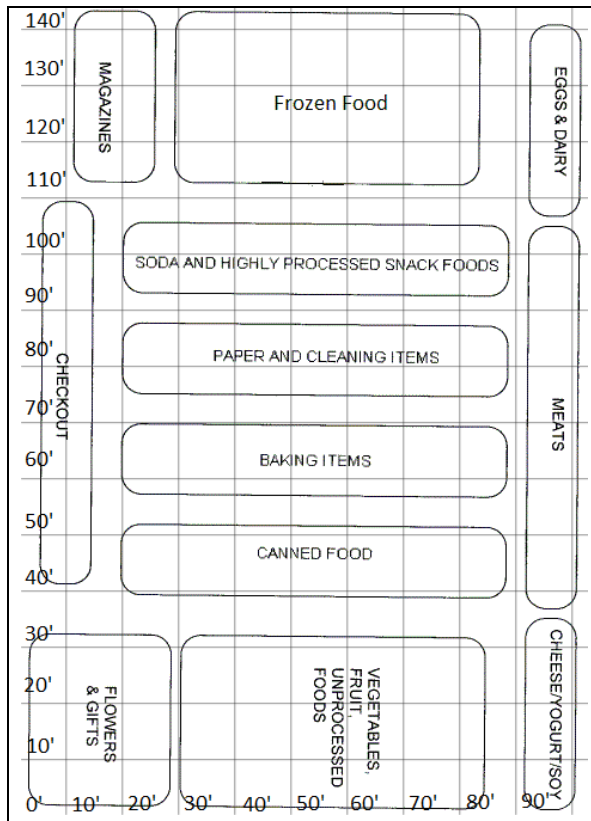
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Fig 2 map with latitude-longitude grid

   - Algorithm:
      i. Compute :
         1. Longitude[] = set of all longitudes
         2. Latitude[] = set of all Latitude
         3. Find : array of allocations
         4. Permutation(all Locations)
         5. For all permutation :
         6. Calculate total distance for that route
         7. If(current Distance < lowest distance)
         8. Update lowest

2. Encryption:
   - As mobile phones are not powerful enough to handle big encryption algorithms without any delay or crash, so, we have to use some light-weighted algorithm like hashing or pretty good privacy.

   - Algorithm:
      1. k = key for encryption.
      2. t = text to encrypt.
      3. res = {empty}
      4. Loop (length of t)
         4.1 cc = character code of current char of t.
         4.2 res = res + to character from code (k XOR cc).
      5. End

B. Data Models

The Frameworks implements approximately all the methods and technologies currently being used in shopping assistance systems.

To be able to modularize all the modules and their technologies swappable, the framework should have all the necessary and optional parameters and data members.

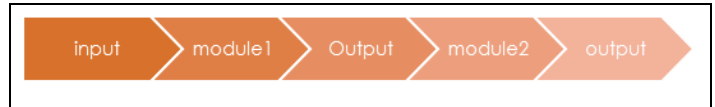To ensure the compatibility, the data objects should have constant mapping.
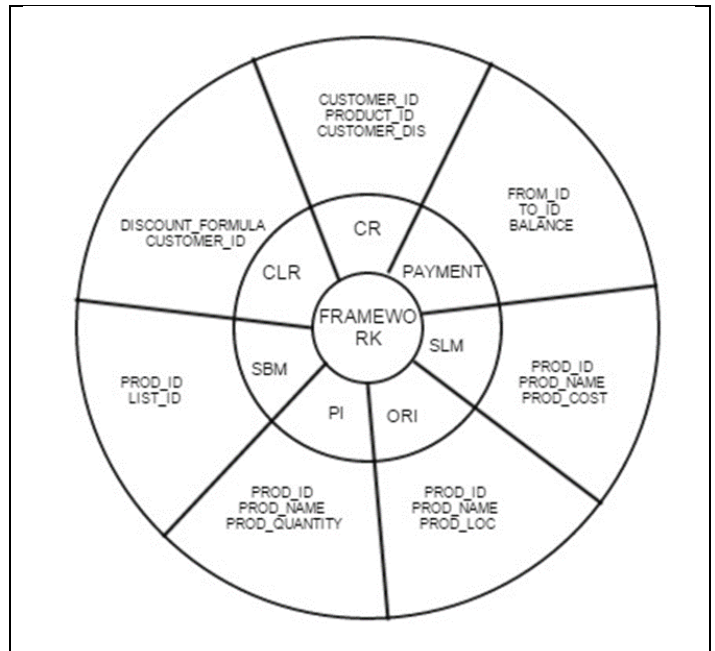

Fig 3. Data flow in framework

Fig 4 Essential data members for framework:

C. Full Data Architecture

apikey	api_key
	userName
bank	bankId
	userName
	name
	balance
	lastUpdate
	email
	cardPin
	expiry
	cvv
	timestamp
cart	userName
	items
	timestamp
coupon	code
	items
	percentage
	timestamp
customer	name
	email
	username
	password
	bankId
	GCMId
	listId
	purchase
	timestamp
featured	index
	code
	imageUrl
	description
	timestamp
location	id
	userName
	message
	seen
	timestamp
lists	listId
	userName
	items
	timestamp
featured	code
	latLong
	pixelLoc
	timestamp
loyalty	userName
	totalPurchases
	totalAmount
	points
	timestamp
manager	userName
	password
	lastLogin
	timestamp
maps	floor
	imageUrl
	imageThumb
	imageFull
	imageAlt

store	itemId
	itemName
	itemPrice
	itemDiscreption
	itemSpecification
	itemCategory
	itemBrand
	quantity
	date
	imageUrl
	itemLocation
	tags
	totalSold
	timestamp
payment	id
	from
	to
	balance
	listId
	timestamp
payment_completed	id
	from
	to
	balance
	listId
	listItems
	timestamp

Table 1. Data members in databse

All the tables and their data members are important for a completely modularized and functional framework.

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