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In-Store mobile shopping for Retail:

Enhancing customer experience using a Middleware Based Intelligent Agent approach

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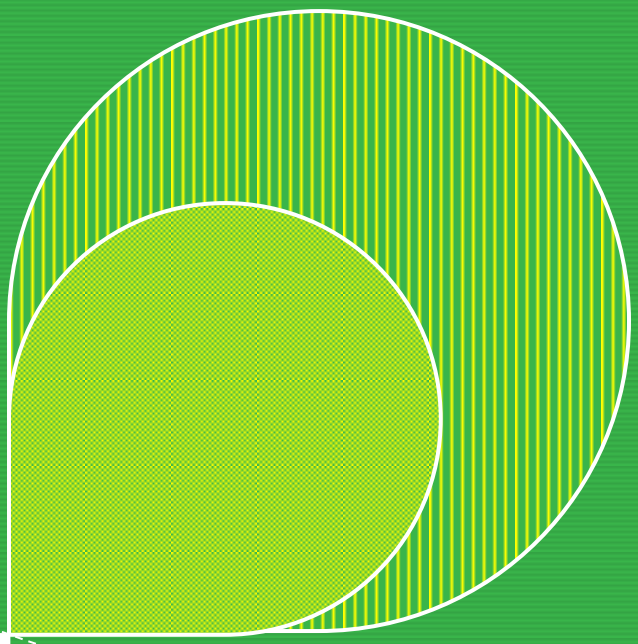

Introduction

What is likely to outnumber the billions of human beings on planet earth over the next few years? The answer: mobile devices. While mobile devices have been around for several years, there are two categories that have resulted in the explosive growth in this industry especially over the last two or three years – smartphones and tablets[i]. Consumers the world over are switching to smartphones and tablets as their default device for communicating, messaging, performing basic tasks and accessing information over the internet. This revolution is impacting various industry sectors, one of the significant ones being the retail industry.

Customers in physical retail stores are increasingly using smartphone applications inside the stores to view product details, using the store mainly to evaluate various products, and reducing their purchases at the store.

For example, customers in physical retail stores are increasingly using smartphone applications inside the stores to view product details, reviews, ratings, and compare prices with those available online. Better (online) deals from other retailers can result, and in many cases are resulting, in customers reducing their purchases at the store, and using the store mainly to evaluate various products. To address this threat, retailers will need to adopt the "If you can't beat them, join them" approach. This means embracing the idea that in-store smartphone and tablet use is here to stay, and enhancing the intelligence of back-end software systems to provide an in-store shopping experience to customers that is seamlessly integrated with the customer's mobile device.

To achieve the above, two key components are needed. One is a mobile shopping application that can be provided by retailers to their in-store customers. The other is a middleware platform that has integration and business logic to gather customer information from multiple sources in real-time, process it and take decisions in real-time. For example the decision could be on the type of offer to be sent to a particular customer based on that customer's preferences and profile. We call the middleware platform an "Intelligent Agent" and this is the subject of this paper.

1. The Mobile Revolution and Retail industry: Key Trends

It is evident that the smartphone and the tablet PC market are becoming more vibrant than the desktop PC industry. As the adoption of smartphones and tablets increases, there is a significant shift in the usage trends of these devices – they are increasingly preferred as the primary device for accessing information over the internet. The other key trend is the use of applications on these devices to perform specific tasks, leading to the growth of application marketplaces.

In the retail industry for example, mobile shopping applications are becoming increasingly popular. Acquity Group's study on how retailers are using mobile application reports that "one in four large retailers now have at least one mobile application". The mobile revolution in the retail industry is being fuelled by the inclusion of smartphone technologies like barcode scanners, QR (Quick Response) code scanners, and geo location based in-store navigation applications.

The mobile revolution represents an enormous opportunity for retailers to engage their customers and improve the overall customer experience

Does this mobile revolution represent a threat or an opportunity for retailers? Some research [ii]appears to indicate the following:

1. More than half of smartphone owners are using the internet in stores, with price comparison, checking store locations and hunting for discounts.
2. About 24% of UK smartphone owners are taking their mobile phones with them in order to compare prices and inform themselves about products.
3. 19% of 2,000 online respondents of a survey had used their mobiles to compare prices and look at product reviews while out shopping.

The above trends definitely indicate a threat, especially to physical retailers – that of shoppers using smartphones to access online content of other retailers and eventually purchasing from online stores or other retailers rather than the store they are currently in.

However, we believe this revolution also represents an enormous opportunity for retailers to engage their customers and improve the overall customer experience. For example QR Code scanned data and geo information can provide insights into customer preferences and location at real time. Based on these preferences and location in a particular store, retailers can then use the mobile ecosystem to send targeted promotions and product recommendations to customers automatically, in real time, and in the context of the store they are in at that moment.

2. Key Challenges for Retailers Today

2.1. Changing Customer Preferences

Customer preferences are ever changing and their behavior within the store also varies from time to time. The lack of real-time insight on customer preferences results in retailers missing out on stocking and promoting products of customers' interest; and thereby missing opportunities in actual sales to a potential customer. Tracking customer preferences, dynamically promoting and stocking products in-store by anticipating customer needs, and increasing the overall level of engagement with customers are some of the key challenges that retail stores are facing today.

2.2. The challenge posed by online retailers

Online retailers are taking a share of the physical retail store sales with most online retailers offering better deals than stores. The stores earlier had the advantage of the consumer enjoying the product just after the purchase, or having multiple payment options such as cash or credit. However, online retailers are now nullifying those advantages by providing attractive features like same-day deliveries and cash on delivery options in addition to online features like product comparisons, reviews and special promotions. Therefore, a larger number of store customers are increasingly moving to online shopping.

In addition, stores sometimes don't have enough information on the products they stock, limiting customers' product choices and decision making capabilities. Customers then employ alternate methods such as smartphone applications[iii] for getting product details and product reviews. They may eventually make a purchase using the same smartphone application over the online channel; affecting the sales of the host store.

2.3 Technology Challenges

To take full advantage of the opportunities provided by the mobile revolution, certain technology challenges need to be overcome.

1. **The problem of 'Disconnected Worlds'**

   Typically, shoppers using mobile applications are in the online world, which is usually disconnected from the physical store they might be in at that moment. For example, In-store IT systems revolve around Point-of-Sale (POS) software – integrating this with mobile applications is a non-trivial task.

2. **Gathering information from multiple sources**

   The consumer will typically use the mobile application in a number of ways – for example, scanning an item for the price, getting product reviews and comparisons, adding and removing items from a virtual 'cart', and so on. These transactions need to be captured and made available to back-end software in real-time and on a per-consumer basis. In addition, a history of past transactions using the mobile application also needs to be collected on a per-consumer basis.

   Information from the Point-of-Sale (POS) software such as transaction history, in-store coupons and offers, loyalty points for the consumer and inventory levels all need to be captured.

   Information available through other channels such as the web (the retailer's online store), news (weather, general trends) and social media is also likely to be of value.

   The number of information sources and the extent of information required to be captured is one of the key challenges.

3. **Deriving customer preferences and trends from the information**
   Based on the information collected from various sources, the next challenge is to process and analyze it, in real-time, to come up with inferences about customer needs and interests.

4. **Converting inferences to decisions**
   Once customer preferences are derived, rapid decisions are needed on the offers that can be sent across to the customers. These offers need to match the alternate ones available to the customer, need to be personalized, and need to be contextual to the physical store the customer is in.

3. Addressing the challenges

The challenges that have been identified vary in scope and size. The key is to address these challenges and simultaneously delivering an enhanced and customer centric shopping experience. This can be achieved by having an IT solution that understands and acts upon customer preferences. We recommend two components for this solution: One is a mobile application platform and the other is an "Intelligent Agent" middleware platform. The pictorial depiction of the overall solution is available in Figure 1 below.

Challenges faced by retailers today can be addressed by having an IT solution with two key components: a mobile application platform and an "Intelligent Agent" middleware platform.

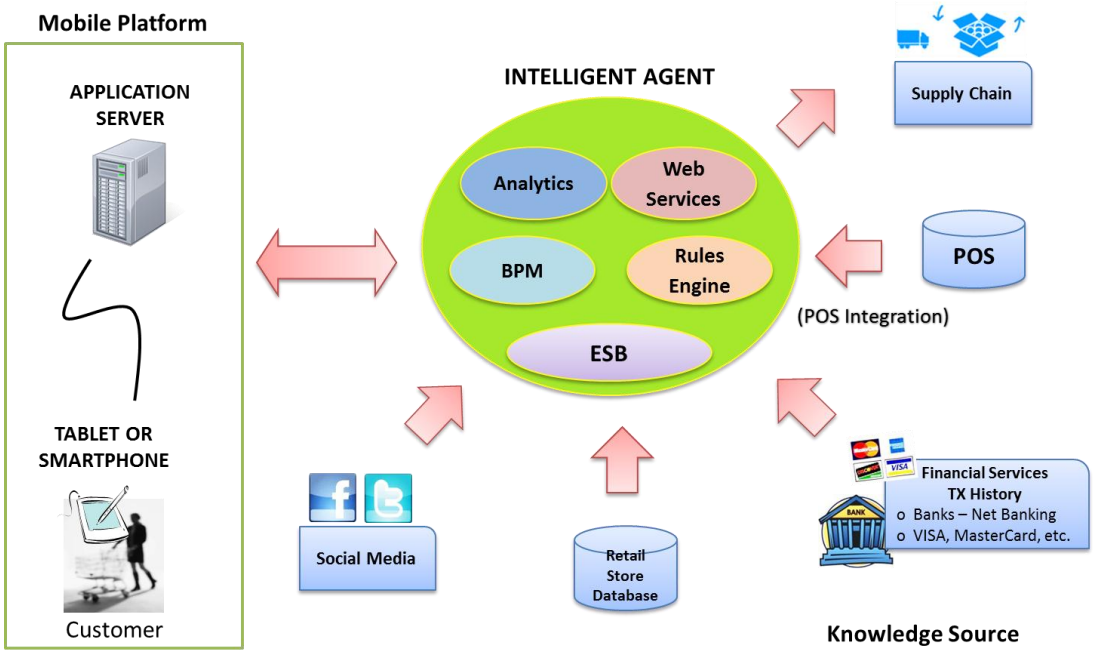

Figure 1: Intelligent Agent interfacing with external systems

3.1. Mobile application Platform

The mobile application platform encompasses a mobile shopping application and the backend servers with which the mobile application will communicate with. The mobile application would typically have features including, but not limited to:

1. Shopping cart functionality (creating, adding items, removing items, checking out a cart)
2. Payment functionality
3. Creation of shopping lists
4. Barcode / QR-code scanning for product lookups
5. Location services such as in-store navigation.

Some off-the-shelf applications for mobile shopping already exist in the market[iv]. The scope of work for this paper does not include the mobile application and is focused around the intelligent agent middleware platform, presented in the next section. For an end-to-end solution, the mobile application could be custom built, or could be one of the off-the-shelf applications available. From the intelligent agent perspective, the key requirements of the mobile application are that it needs to provide location data and customer transaction information to the agent, on a real-time basis.

3.2. Intelligent Agent

This is the heart of the system design and is the subject of the rest of this paper.

4. The Intelligent Agent

The Intelligent Agent has been designed as a layer of business logic on top of standard middleware. The justification for a middleware based approach is straightforward, since one primary responsibility of the Intelligent Agent is the *integration* of multiple information sources, which is best achieved using middleware.

The components of this middleware platform are mentioned in section 4.5.

The Intelligent Agent has been designed keeping three responsibilities in mind:

1. Act as an 'Integration Broker' between the knowledge sources and the mobile application platform as depicted in the Figure 1.
2. Execute business logic to provide recommendations based on customer need and interests.
3. Help in intelligent demand forecasting and anticipation of customer needs.

4.1. Act as an 'Integration Broker'

In order to better deliver customer centric deals and promotions it is essential for the Intelligent Agent to know the complete profile of the customer and his needs, interests and buying patterns. In addition, the Intelligent Agent needs to collect information about products and brands, as well as market data such as news, trends, demographics, and so on. Such information could be tapped from various sources:

1. **Mobile Transactions and Location:** This includes customer interactions with the mobile application; transactions for which can be obtained from the mobile application platform. This also includes location coordinates of the customer, from which the store location needs to be computed. The store location can be a feature of the mobile application, or can be implemented as additional functionality in the Intelligent Agent.

2. **External Knowledge Sources:** These include Point of Sale (POS) software in stores, online channels, Social Media, as well as third party sources such as financial service providers.

Point Of Sale (POS) Systems

Typical POS systems handle a number of customer and store related functions such as sales, gift cards, gift registries, customer loyalty programs, inventory, offers and much more. Integration with POS systems will enable the Intelligent Agent to retrieve data like inventory and promotion availability, along with customer information like purchase history and loyalty points. This information can then be used to determine the appropriate in-store offer for the current consumer in the store. For an enhanced in-store mobile shopping experience, the most critical interface for the Intelligent Agent is with the POS[v].

Online Channels

These are basically web sites which can provide information on various aspects such as product prices and reviews, brand information, news, trends and weather alerts.

Social Media

Social Media are a channel through which the Intelligent Agent can retrieve information related with consumers as well as brands. Consumer information can include profile information and interests. Brand information can be derived using the concept of "sentiment analysis".

Financial Services

Financial service providers such as VISA, MasterCard and card providers such as banks hold data on customer purchase transactions. This information is valuable since those transactions may not have been through the retail store. Integrating with such sources can help the Intelligent Agent to identify purchase patterns and trends across various customer segments[vi].

Integration Approach

There is a challenge in integrating these different sources seamlessly with the intelligent Agent. We suggest an approach that will be to use an integration bus– a combination of an Enterprise Service Bus (ESB) and a messaging bus preferably Java Message Service (JMS) for integration with the mobile application platform and knowledge sources.

At a high level, integrating with these external systems would involve the following steps:

1. Identification of Application Programming Interfaces (API) that may be available from each of the knowledge sources. In case APIs are not available, data level integration at the database or file level would need to be explored.
2. Corresponding to the feature set needed by the mobile application platform, building of web service interfaces for request-response interactions and JMS interfaces for the asynchronous interactions.
3. Developing business logic in the interfaces as per the "VETRI" concept, which stands for Validate, Enrich, Transform, Route and Invoke.
4. Hosting the web services and JMS interfaces on the integration bus.
5. Make necessary changes in the external systems to invoke the web services and JMS interfaces.

4.2. Business Logic to provide recommendations

One way a retailer can ensure a memorable shopping experience is by providing what the customer wants even before they are sure of what they want. The Integration Broker functionality discussed above helps the Intelligent Agent to gather customer information from different sources. The next step is to process and analyse this information to identify the potential customer needs; which are then used to deliver personalized recommendations on products, shopping lists, deals and coupons.

It is important to time the delivery of the recommendations correctly to maximize the chances of making a sale right when the customer is most likely to accept the recommendation.

For example, a teenager might receive recommendations specific to his or her needs (sports items for somebody interested in sports). Another example could be during the "back to school" season when a father shopping in the store might receive recommendations on school supplies for kids. The Intelligent Agent can get information about the teenager and the father through the external systems.

The processing and recommendation logic is typically implemented as algorithms on a rules engine or analytics engine. Use case identification and algorithm design was one of the key focus areas of this work, some use cases and algorithms are described in section 4.4.

Apart from identifying customer needs and delivering recommendations accordingly, it is also important to time the delivery of the recommendations correctly. This can maximize the chances of making a sale right when the customer is most likely to accept the recommendation. The Intelligent Agent dynamically identifies the best timing for recommendations delivery based on the customer activity like customer entering the store, passing a particular aisle, nearing a particular aisle, or walking away from an aisle.

4.3. Intelligent demand forecasting

The Intelligent Agent, having understood customer interests of both in-stock and out-of-stock products, trends in the purchase patterns, and inferences derived from other information sources such as news; can use these to forecast category and product demand

and replenish stocks in anticipation of demand. This can help lower out of stock ratios and significantly enhance the customer experience. In Figure 1, this is shown as an outbound interface towards the Supply Chain Management systems.

4.4. Algorithms and Examples

The Intelligent Agent (IA) will use intelligent algorithms to translate the customer behavior and information to customer interest and needs. As part of this work, multiple use cases for customer behavior were defined, two of which are presented below[vii]. Additionally, for each use case, there was an algorithm definition activity, with associated pseudo code. Some pseudo code examples are also presented below[viii].

In all these examples, the assumption is that the customer is in the physical retail store using a mobile application with the features described earlier. Such an application would typically be provided by the retailer[ix].

CASE 1:

	Action	Algorithm Code and Methods

1.	Suzan scans a wrist watch, reads reviews and adds it to her mobile shopping cart. Later for some reason she decides not to purchase it and removes it from the shopping cart	`addToCart(WristWatch)`
		`removeFromCart(WristWatch)`
		`readReview(WristWatch)`
		`bookmark(WristWatch)`
		`Update_CategoryScore(WristWatch)`

2.a	The Intelligent Agent (IA) understands that Suzan is interested in the wrist watch and may purchase it if there was any deal or a promotion given to her and triggers possible offers for the wrist watch.	`WristWatch.CategoryScore>= CategoryScoreThreshold`
		
		`search_Promotions(WristWatch)`

2.b	Suzan moves away from the watches aisle without purchasing the wrist watch. The IA understands that it is time to remind her of the wrist watch that she was interested in along with a promotion and triggers promotions on the go.	`on_Aisle_Change(Watches_Aisle)` `search_Promotions(Watches_Aisle)`
3.	The deal, coupon or promotion is pushed to Suzan's mobile app	`send_Promotions_to_Mobile()`
4.	Suzan happy with the deal she has received adds the watch to her mobile shopping cart and makes the purchase through her mobile or the store.	`addToCart(WristWatch)` `on_Purchase(WristWatch)`

For each product that the shopper is viewing the Intelligent Agent tracks the user's activity through a table known as "Shopper Engagement Directory". The Shopper Engagement Directory helps the Intelligent Agent to calculate a 'Category Score' for each product. The

Category Score denotes the customer's interest level towards a product within the same category. For example: for the category Video-Games, a customer's interest on a particular video game, say Mario, can be understood from the Category Score for that game.

Typically, retailers would organize their products into various levels of categories, each having their own sub-categories. For example, we could have a category hierarchy such as Apparel & Accessories > Clothing > Casuals > T-Shirt. Having a Category Score for each product also helps in identifying the interest level for each category. For example, from the captured Category Score of two different product T-Shirts and Trousers of the same category *Casuals*, the Intelligent Agent can estimate the Category Score of the category *Casuals* and therefore its interest level. A pictorial representation of the Category Score approach to find the Category Score of the higher level is shown in Figure 2.

This approach can help in triggering promotions based not only on the customer interest towards an individual product but also on the score for an overall category level. The Category Score approach lets the Intelligent Agent cater to many cases of user interaction where an individual customer or a customer segment's interest is the key consideration to deliver promotions and recommendations. Consider the following example:

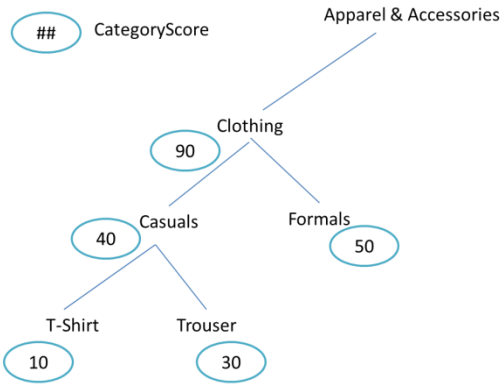

Figure 2: Category Score – higher category level

CASE 2:

	Action	Algorithm Code and Methods
1.	Joel enters the store in summer and scans some T-Shirts	`on_Customer_Entry(Joel)`
2.	From Joel's Category Score of Casuals, the IA infers that Joel could be interested in other Casuals as well.	`Joel.Casual.CategoryScore >= Casual.CategoryScoreThreshold`
3.	Since it being summer, the IA understands that now may be the right time to send offers on additional Casuals.	`positive_Relation(Casuals,Summer)`

4.	The IA searches deals and recommendations for products under the category Casuals (E.g. shoes) and sends to Joel's mobile.	`search_Promotions(Casuals)`
		`search_Recommendations(Casuals)`
		`send_Promotions_to_Mobile()`

5.	Joel using the deals and recommendations that he has received, adds products to his mobile shopping cart.	`addToCart(WristWatch)` `on_Purchase()`

4.5. Intelligent Agent Architecture

The Intelligent Agent must be seamlessly integrated with the mobile application platform, POS software, and all the other external systems. As mentioned in section 4, this is the primary reason why a middleware based approach is recommended. The middleware stack includes the software components described below.

4.5.1. Enterprise Service Bus (ESB)

ESB is an application integration technology which acts as an intermediary through which the Intelligent Agent can communicate with the external systems. The ESB involves mapping data to a format compatible with the interacting systems and routing of messages to their proper destinations.

4.5.2. Analytics Engine

The analytics engine is essentially an inference engine. It helps process the data from the various sources and makes sense out of them in terms of consumer interests, trends and patterns. It can understand the buying pattern of the consumers and also come up with a recommendation of products. Backend monitoring and trend analytics can also help retailers in stocking products and making decisions. From a technology implementation perspective, one option for the analytics engine is a Complex Event Processing (CEP) platform.

4.5.3. Rules Engine

Business rules change more frequently than the rest of the application code. A Rules Engine enables externalization of business rules and this allows the application and the users to modify the rules easily. The system as a whole becomes more adaptable with business rules that can be changed dynamically. Rules can be implemented for recommending actions based on a customer activity or a behavior; for example: if customer scans the barcodes of a variety of T-Shirts for a specified number of times, an action such as ‘send promotion for T-shirts’ can be triggered.

4.5.4. Business Process Management (BPM)

The gap between customer expectations and the ability of the Intelligent Agent can be maximized by defining processes that are efficient and effective in delivering what customers require. BPM is used to define the processes which are critical and customer-driven, satisfying and creating loyal customers.

5. Conclusion

The trend of customers using mobile devices such as smartphones and tablets while they are doing their in-store shopping is here to stay. Retailers can take advantage of this trend by providing and end-to-end solution to their customers. This would involve a mobile shopping application at the front end, and an intelligent middleware platform at the back end. The intelligent middleware platform would integrate information from multiple sources, process it using pre-configured business rules, and deliver recommendations and promotions to the customer’s mobile application that are relevant to the customer’s interests as well as

location in a particular store. We believe such an approach will make a significant difference towards retailers being able to ensure an enhanced in-store shopping experience for their customers.

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Endnotes

[i] In the last quarter of 2010, sales of smartphones outpaced that of PCs for the first time, according to data from IDC. A consolidated Analyst report from 14 leading Bank Analysts and 6 Tech Analysts reports for 2012 by UberMobile-ZDNet suggests that the tablet market would reach 300million in 2016. Cisco has predicted that by 2016 there will be more mobile devices than the people on Earth.

[ii] Survey results from Toluna/Econsultancy and iModerate surveys and Google's "Our Mobile Planet" data on the smartphone usage in the Retail stores were researched upon.

[iii] Amazon price check and Google Shopper are two such examples

[iv] Examples are products from vendors like AisleBuyer and NearBuySolutions

[v] Interface design is out of the scope of the current work – the authors may be contacted for details.

[vi] This will require a partnership between the retailer and the financial services provider

[vii] The authors may be contacted for the other use cases.

[viii] The authors may be contacted for pseudo code related to other cases

[ix] Several retailers already have smartphone applications available for most of the major platforms

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Happiest Minds, the Mindful IT Company, applies agile methodologies to enable digital transformation for enterprises and technology providers by delivering seamless customer experience, business efficiency and actionable insights. We leverage a spectrum of disruptive technologies such as: Big Data Analytics, AI & Cognitive Computing, Internet of Things, Cloud, Security, SDN-NFV, RPA, Blockchain, etc. Positioned as "Born Digital . Born Agile", our capabilities spans across product engineering, digital business solutions, infrastructure management and security services. We deliver these services across industry sectors such as retail, consumer packaged goods, edutech, e-commerce, banking, insurance, hi-tech, engineering R&D, manufacturing, automotive and travel/transportation/hospitality.

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