

Smartphone Based Shopping Model for Smart Market: An Interaction Design Perspective

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Abstract: Shopping is an important aspect of human lifestyle and the advancements in technologies are influencing this aspect of life as well. Most of the people still prefer to go to markets for daily groceries and utilities shopping. Traditional shopping style in the market is very hectic and inefficient because the customers have to search for products on their shopping list, select items about which they don't have much information and have no way to compare products from different shops. This study presents a smart market model which offers dynamic information provision based on two alternate approaches. The users do not need to physically search for and select any product. Rather, view items on the smartphone while being in the market vicinity, compare and select products, order products via the smartphone and then collect the order at the counter in the shop. The model offer review and analysis service for both customers and sellers. A detailed interaction model for each process in the form of sequence diagram and business process model has been presented in the study.

Key words: Smart shopping, interaction model, smart market, sellers, smartphone

INTRODUCTION

Shopping, especially for daily utilities and groceries, in the modern day lifestyle is a very hectic job. Even, the large malls and marketplaces have problems for the customer locating products and getting information regarding products. The traditional shopping models lack the ability to introduce new products to the customers while they are shopping hence resists the growth of new products. Above are only a few of the problems associated with traditional shopping model which caused a transition towards modern shopping malls and online shopping model (Adams, 2003). As time passes more and more people are opting for the innovative shopping styles as described in the survey by TNS (2008). The future shopping malls and market places will be able to deliver dynamic information regarding products such as pricing, contents and comparisons with other similar products. Customer profiles will be maintained and based on their preferences promotional advertisements and recommendations would be provided to customers. Customer will be able to maintain a record of his/her purchases while sellers can review their sale trends for directing their investments towards appropriate products and services. In short smart shopping and market places will benefit both customers as well as sellers.

Previously, efforts have been performed with the motivation to include intelligence or context-awareness to

the shopping cart. One of such efforts is the Smartcart implementation presented by Kahl *et al.* (2011). The Smartcart was intended to act as a user adaptive and context-aware shopping assistance. Radio frequency identification tags had been used to identify the products that were being selected to put into the shopping cart. IRL Smartcart used the same technology to determine the position of the cart in the shop environment in order to provide location based services such as personalized shopping lists and navigation service to reach product locations (Kahl *et al.*, 2011). Medicart is one of the popular implementations of smart shopping cart (Medi-cart). Medi-cart assists the customers in the shopping mall by providing information regarding products, locations, pricing and advertisement via the cart's display.

Mobile phones have been widely used for marketing communication in consumer markets (Watson *et al.*, 2013). The current advancements in smartphone and data networks, the focus is changing towards smartphone based shopping assistance and guidance systems (Gao *et al.*, 2013). Chu *et al.* (2013) presented their smart shopping system based on RFID smart cards to identify customers, provide product advertisements and recommendations to similar customers based on the relationship information called as social vectors (social vectors) from their social networks. RQ codes based

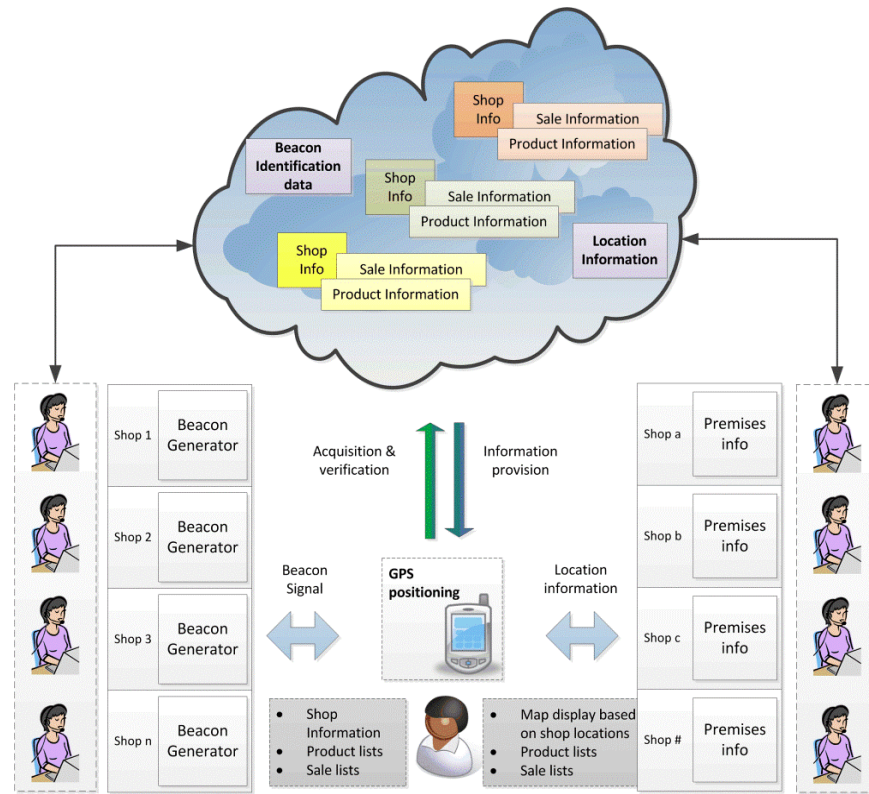


Fig. 1: Smart market information provision scenarios

shopping guidance systems have been developed in the past to assist user shopping in larger shopping malls. Fupresented QR code recognition based shopping guidance system (Fu, 2011). The system uses smartphone camera to scan QR codes on the products in order to get information related to the product from a remote web server. A mobile application is used as front end to browse the web contents related to the identified product.

iGrocer project used smartphone and a barcode scanner to assist the users in their shopping for daily groceries (Shekar *et al.*, 2003). iGrocer was more focused towards users with disabilities to aid them in buying products according to their nutritional requirements and price limits. This functionality was achieved by maintaining a detailed profile of the user locally on the smartphone. Similarly, Chen *et al.* (2013) intends to enhance the vendor performance, analysis of customer preferences and response based on customer behavior. Chen uses RFID readers in conjunction with smartphone and an application for user to visualize and navigate data.

All the shopping assistance and smartcart solutions requires the users to carry a shopping cart, search the

location of the products, move the cart to the location and pick the products. These solutions may have demonstrated some percentage of the user time saved but still more efficient and easy to carryout processes need to be formulated in order to reduce the time spent on shopping and rather use it in more productive or important activities. This study presents a new smart market model where the customer does not need to carry a shopping cart or even move to the product locations in order to get information regarding the products and/or purchase any product. The proposed model suggests dynamic information provision scheme to the customers who are in the vicinity of the smart market. The information provision scheme has been described in terms of two separate approaches, e.g., push approach and pull approach.

The first approach is a push service based on beacon signals generation to notify users while the second approach is a pull service based on location identification and information provision. Figure 1 illustrates both of the approaches via a single graphical representation. Researchers suppose a marketplace where there are several shops on both sides of a passage way. The shops on the left are using the push service approach while the

shops on the right are using the pull service approach to the smart market solution. The shops on the left continuously generate a beacon signal and each signal is different from each other. Most of the modern smart phones are able to receive a beacon signals, so as the user with a smartphone passes through the passageway. The smartphone receives beacon signals from the shops as it enters the range of the beacon generator. The smartphone then, uses its carrier network to connect to the smart market system to send the shop identifier received through the beacon signal. The system then queries the associated database based on the shop identifier and gets the related information such as shop name and category. This information is sent to the requesting smartphone and the smartphone then alerts the user. If the user wishes to check the product catalog from the shop then he/she must choose to get detailed information. The smartphone then, requests the smart market system to provide detailed information in the form of catalog lists, sales promotions and advertisements.

Apart from the information provision schemes, the proposed model offers process modeling for smart market purchase process, shopping review and sales analytics processes. The proposed model is unique in the sense that it does not require the customers to follow the traditional hectic way of shopping, customer's family (kids) will not get bored with the parent walking along the isles in search of products and parents can easily shop through their smartphones while they enjoy watching their kids play in the playpen of the mall or marketplace. Smart market offers an easy way to save customer's precious time that can be spent with family and kids rather than spent while walking through the aisles of a shopping mall. Concept to their business process of selling products and avail smart analysis service for their business. Consumer is any person who shops for daily life utilities and would like to facilitate and make easy the hectic job of going to shops and looking for the desired products. In order to avail the smart market services, the consumer needs a smartphone which is now used as a daily life utility device by almost all the people in the society. The central smart system is the main component which glues together.

MATERIALS AND METHODS

Conceptual architecture: The major entities that constitute the proposed smart market scenario are the provider, consumer and the central smart system. As illustrated in Fig. 2, provider can be any shop that wants to incorporate the proposed smart market diverse

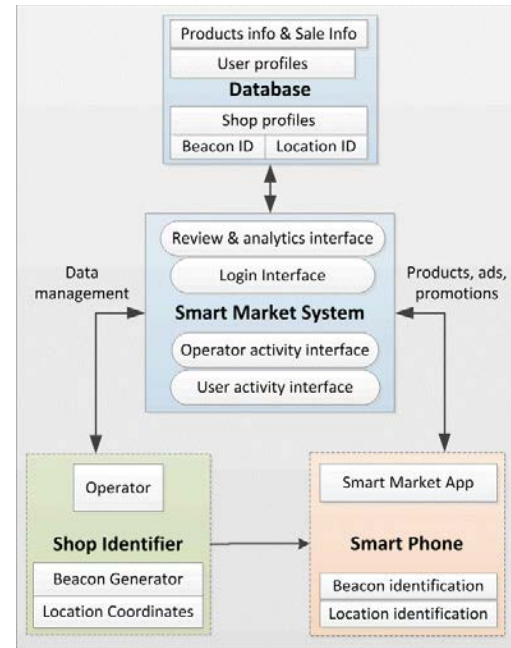


Fig. 2: Conceptual architecture for smart market system

providers and consumers based on the smart services it provides. The central system in the proposed scenario is called as the smart market system.

Smart market system provides services for the smart shops (providers) to maintain an online/cloud based profile for their shop. The shop profile consists of basic information regarding the shop such as the shop name, category and information provision approach, e.g., push or pull. Using the shop profile, the owner/operator of the shop manages an online catalog of their products along with the information about any discount sales or product promotion operations. This information is used by the smart market system to notify consumers about the promotions and sales based on their interests and history of purchases. Smart shops can also utilize the sales analytics service to analyze their sales trends based on time and customer interests, thus, providing a facility for the smart shops to adjust their supply chain accordingly and invest in a better way.

Smart market system enables an ordinary smartphone to assist its user in his/her shopping activities. Two approaches for information provision to the clients may be used with the smartphone. The beacon based approach acts as a push service for the smartphone to detect beacons from smart shops. These beacons are used to get information regarding the particular shop from the smart market system and provide the information to the user. The second approach acts as a pull service where the smartphone, based on its GPS receiver readings, queries the smart market system if it is in the

area range of a smart shop and thus, getting related information for provision to the user. Thus, the users can be provided with shops' information and products information through their smartphones while they pass through the smart market area. Smart market provides the consumers/clients with an easy way to shop for their required products. The consumer can get information on the go about shops and the products available in those shops. Similarly, the clients get notifications regarding product discount sales and promotions and they can easily view the product descriptions, prices and easily compare different shops while moving in the market place. The database associated with the smart market system is used to save all the purchases made by a user and hence, a record is maintained for later review and analysis of the shopping by the particular user.

Interaction modeling (sequence model): This study provides the graphical representations of various functions of the smart market system in the form of sequence diagrams. Each sequence diagram includes the objects and the sequence of messages exchange among them in order to fulfill the task.

These sequence diagrams include push and pull approach based information provision to the user, order placement by the user, shopping history review by the user and sales review by the shopkeeper (operator). Each of these sequence diagrams have been briefly described in the following subsections.

Beacon based information provision (Push approach): In the proposed smart market scenario, the user must be able to get information regarding the shops and its products along with any sales promotions, etc., Push approach is a well-suited solution for information provision while the user is on the go. As shown in Fig. 3, using push approach, the user need not to specifically send requests to the system in order to get the information rather he/she subscribes to the push service by the smart market system just once. Each shop in associated with the smart market system has a beacon generating device which generates a Bluetooth technology based signature signal. Most of the modern day smartphones are able to receive these signals and process it in order to extract the unique identifier from the signal.

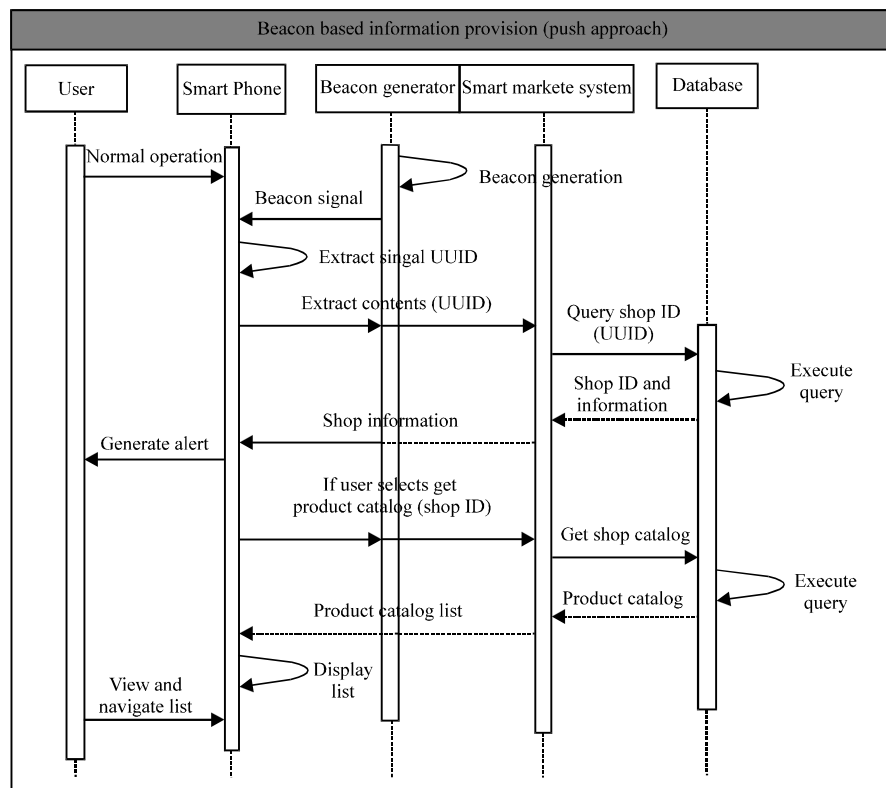


Fig. 3: Beacon based information provision sequence (push approach)

This unique identifier is used as an identifier for the shop and based on this identifier the information related to the specific shop is automatically requested from the smart market system. The system queries its associated database and retrieves basic information about the shop. This information may also contain any new discount offers from the shop or promotions data. The information is sent back to the smartphone which displays it on the screen and generates an alert to notify the user. If the user wishes to see detailed information such a product catalog and detailed descriptions of the discount offers and promotions, the user may explicitly select it and the smartphone will then request the smart market system to provide the requested data to be visualized by the user.

User location based information provision (Pull approach): Figure 4 presents an alternate approach for information provision to the users of the smart market

system. Using the pull approach, the smartphone monitors the location of the smart market user. For this purpose, the user of the pull approach must login through a smartphone application which will act as a smart market client application. Figure 4 shows that the user provides a pre-issued client certificate to login to the system. The smartphone uses the integrated Global Positioning System (GPS) receiver to constantly monitor the current position of the user. The location of the user is displayed on a map displayed on the screen. The map data is obtained by the smartphone from a map server such as Google maps. The smartphone sends the user location coordinates to the smart market system to check whether the user is in close vicinity of a smart market associated shop. If the user is found to be near enough to a smart market shop, the shop information is requested by the smartphone of the user. The provided information is displayed on the map as an icon and a notification is generated to

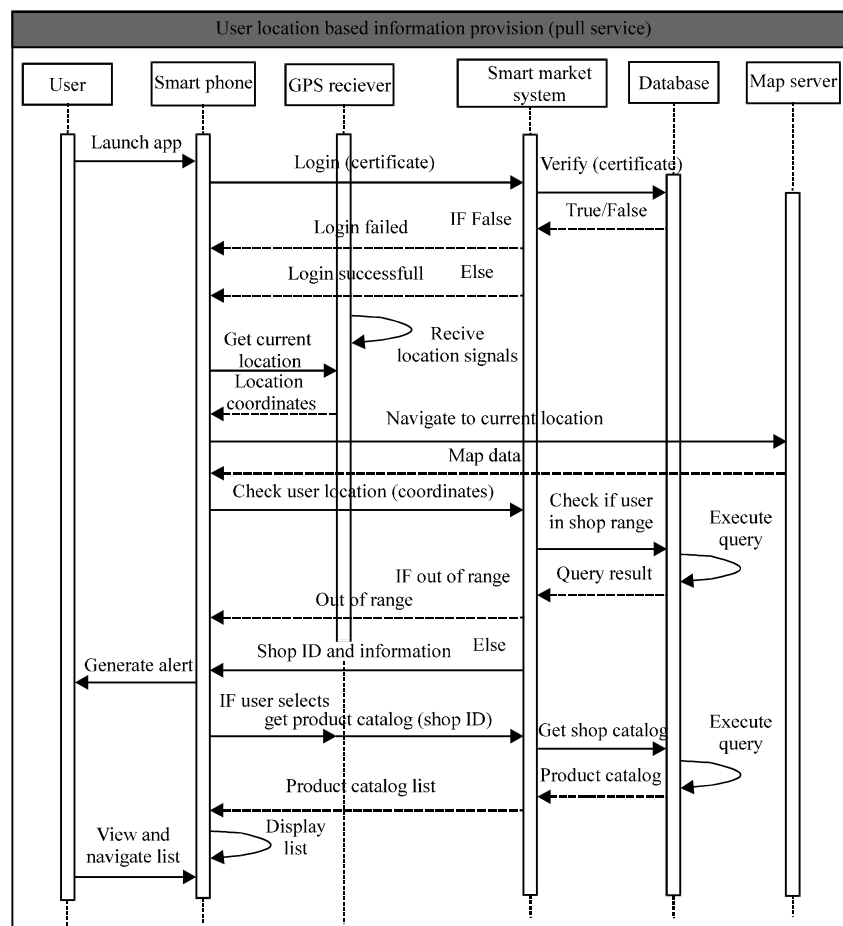


Fig. 4: User location based information provision sequence (pull approach)

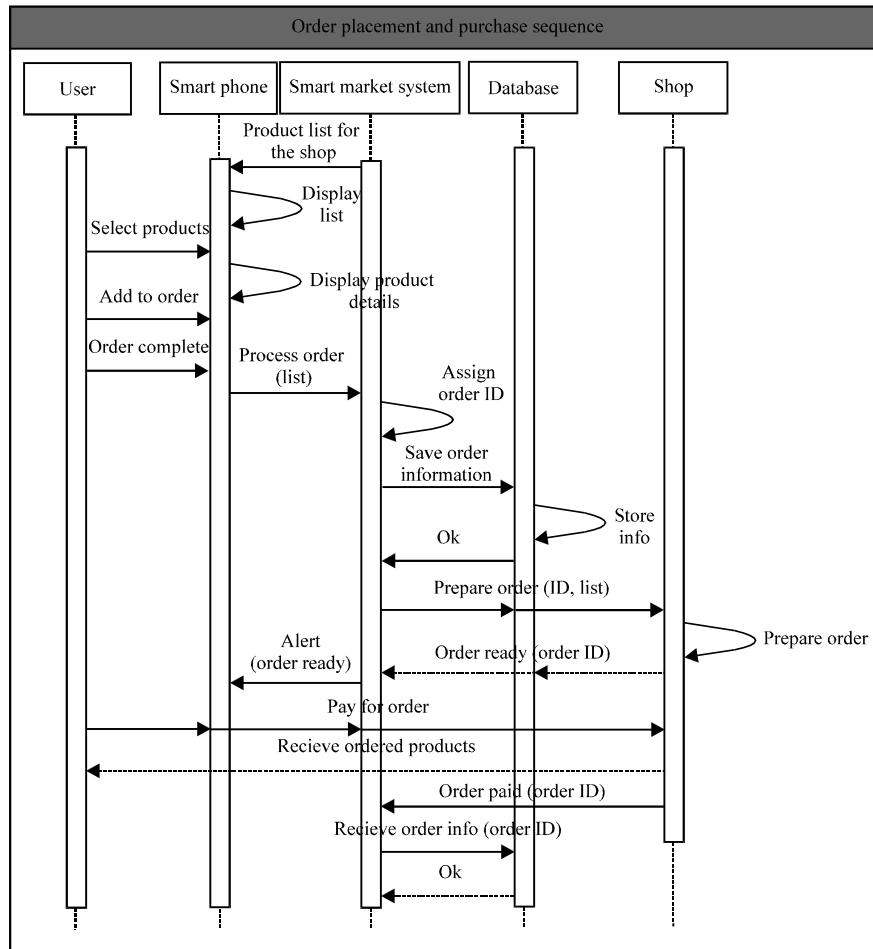


Fig. 5: Order placement and purchase sequence

alert the user. As the user passes through the smart market area, shops are being displayed on the map. If the user wishes to see detailed information such a product catalog and detailed descriptions of the discount offers and promotions, the user may explicitly select it and the smartphone will then request the smart market system to provide the requested data to be visualized by the user.

Order placement and purchase: Figure 5 illustrates the order placement and purchase task in the form of a sequence diagram. This task can only be carried out if the user is already been provided with the shop information and product catalogs along with the discount promotions or other information. The smartphone displays all the products in the form of lists and the user selects products that she wants to add to her order. Once the complete order is selected by the user, the process order sequence is initiated. The smartphone sends the list of selected items to the smart market system. The order is assigned a unique identifier and the order data is saved for future

reference. Smart market system then notifies the shop operator to prepare the order. Once the order is ready, the user is notified about the payment for the order. The user then pays for the order and receives the purchased products. The information about the whole transaction is updated in the order data stored in a previous step.

Shopping history review by user: Smart market system enables the users to keep track of their previous purchases. This facility enables the smart market user review his/her expenditures on shopping and adjust budgets accordingly or may be used to compare the users shopping expenditures at different times. Figure 6 illustrates the shopping history review task in the form of a sequence diagram. The user must first login to the smart market system via the smartphone application and by providing her certificate. Once the user successfully logs in to the system, the user activity interface is loaded by the smartphone application. User can then select the shopping history review option to load the review panel.

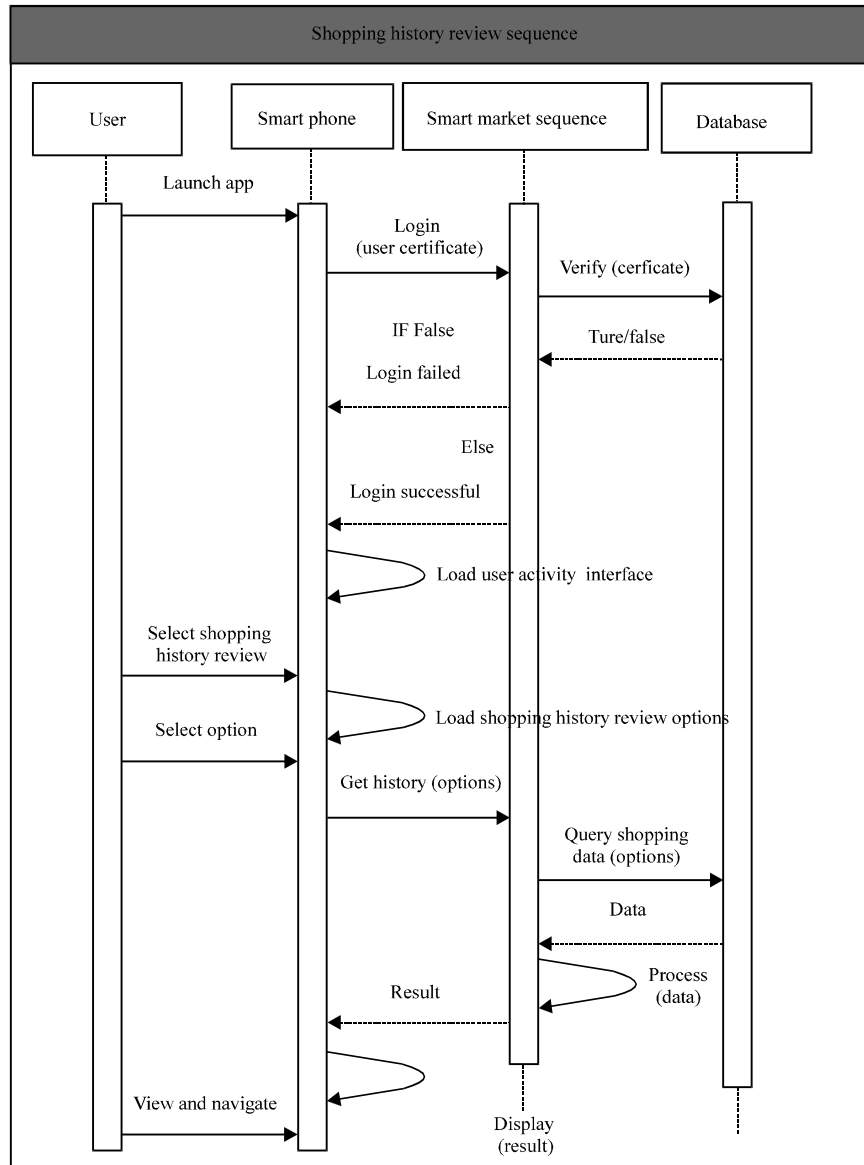


Fig. 6: Shopping history review sequence

The review panel includes various options for reviewing the shopping history such as dates based review, products based review and price based review, etc., The user can then select an option and the smartphone process the selected option to send a generic query to the smart market system with user selected options as parameters. The smart market, after receiving the generic query from the smartphone, creates a database query and runs it on the associated database. The data returned by the database in response to the executed query is processed by the smart market system to convert it into generic form. This generic data is easily formatted into lists which are easily displayable by the user

smartphone. The user then visualizes this data and may navigate through it according to her requirements.

Sales history review by operator: Smart market system offers a shop's salesperson or operator to review the shop's sales history. This facility enables the operator to review and analyze sales with respect to time of the year, sales based on the promotions, discounts and customer interests in various product types. Such information may also be used for future advertisements and promotions using the smart market. Figure 7 shows the sales history review task in the form of a sequence diagram where the operator acts as the user of the system.

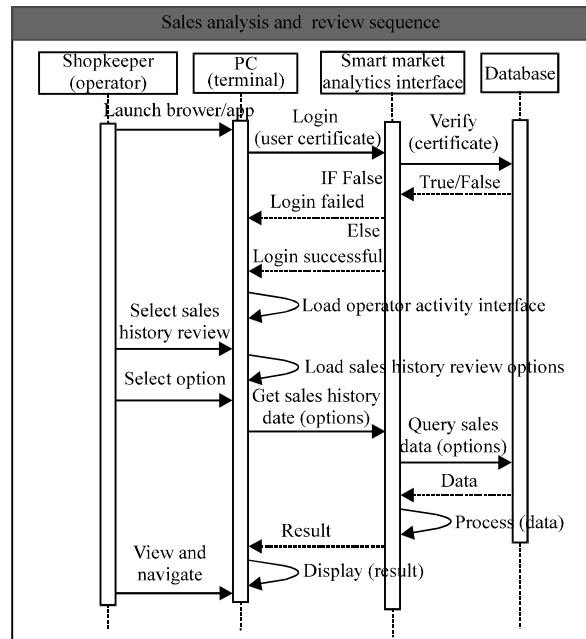


Fig. 7: Sales analysis and review sequence

The salesperson or the data entry operator at the smart shop can login to the smart market system. Again, the access to this system may be granted through a common web browser or dedicated client application that the operator runs on a personal computer or smartphone. The operator at a specific shop may use their unique certificate or location identifier to login to the system. At successful login, the operator activity interface is loaded, through which the operator can visualize various options related to the sales history from the perspective of time, customers, discounts and products promotions. This information can be used to identify the trends in product sales based on time of the year, months or even days of week. Similarly, the sales trends based on promotions and advertisements can also be monitored.

RESULTS AND DISCUSSION

Interaction modeling (business process model): Figure 8 presents a generic process model for Beacon based smart market information provision. Beacon presents any Push Servicewhere the user does not need to explicitly request for certain information, rather the information is provided to the user when a new event occurs and some new information is generated based on that event. Users normally subscribe for a specific push service and then they receive the subscribed information based on the event occurrence. The process model in the figure visualizes the concept from the perspective of smart market.

Each shop in the smart market has a beacon generator which continuously generates a beacon signal. Most of the modern smart phones supports push service and are able to receive and process a beacon. As the user enters the range of a beacon generator, the smart phone receives the unique identifier from the signal. This unique identifier is used to automatically access the online catalog for the specific shop and any advertisements related to sales on products or product promotions are sent to the smart phone. In order to identify the user, each user has a unique identifier or certificate which is provided at the time of subscription to the smart market push service. This way the as the use enters the range of its favorite shop, the shop information, catalog, sales information and other promotions can be viewed by the user using his/her smart phone.

Figure 9 shows the business process model for location based smart market scenario. The process is based on Pull approachwhere the user must explicitly request for certain information and then the information is received by the user. The pull approach based smart market information provision process starts when the user logs in with a specific smart phone application. The smart phone then acquires GPS coordinates at specified time intervals and accordingly updates the map. If the acquired location in the form of GPS coordinates is found to be inside the range set for one of the shops in the smart market database, the advertisement information, catalogs and sales information related to the shop are queried from the database and sent to the user.

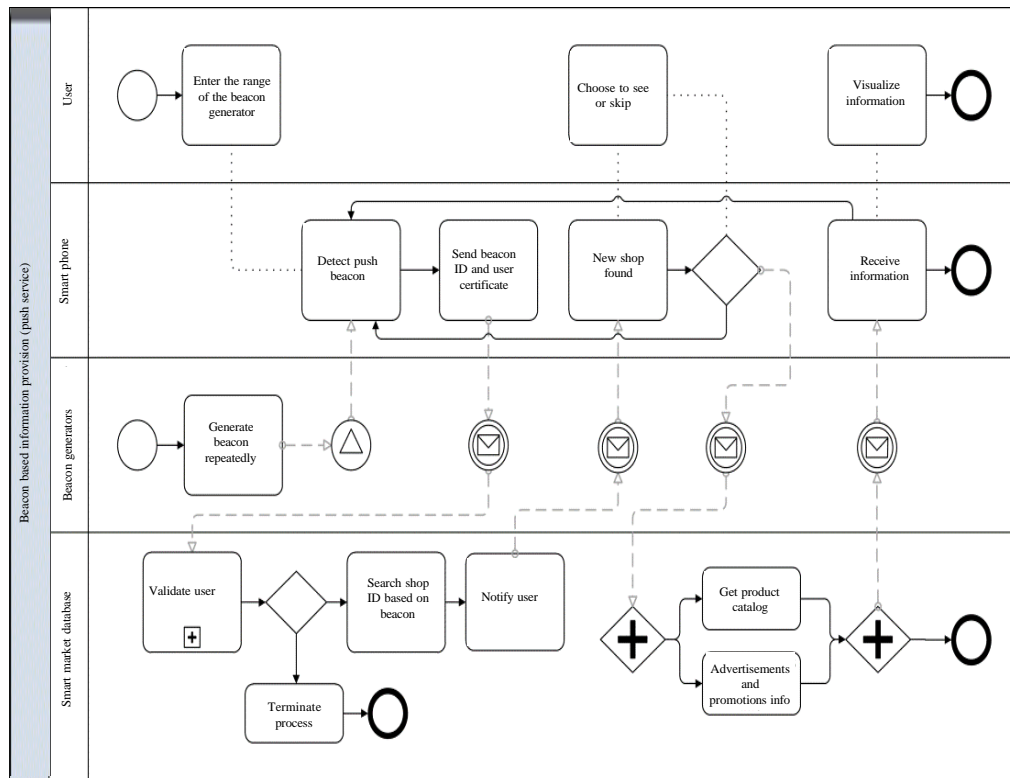


Fig. 8: Business process model for beacon based information provision

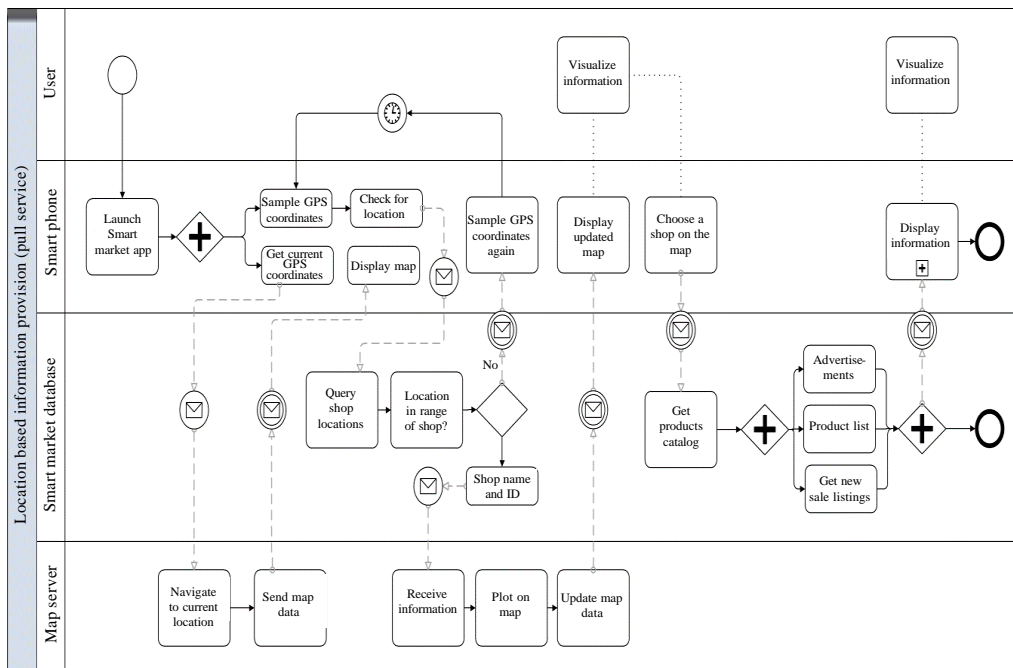


Fig. 9: Business process model for location based information provision

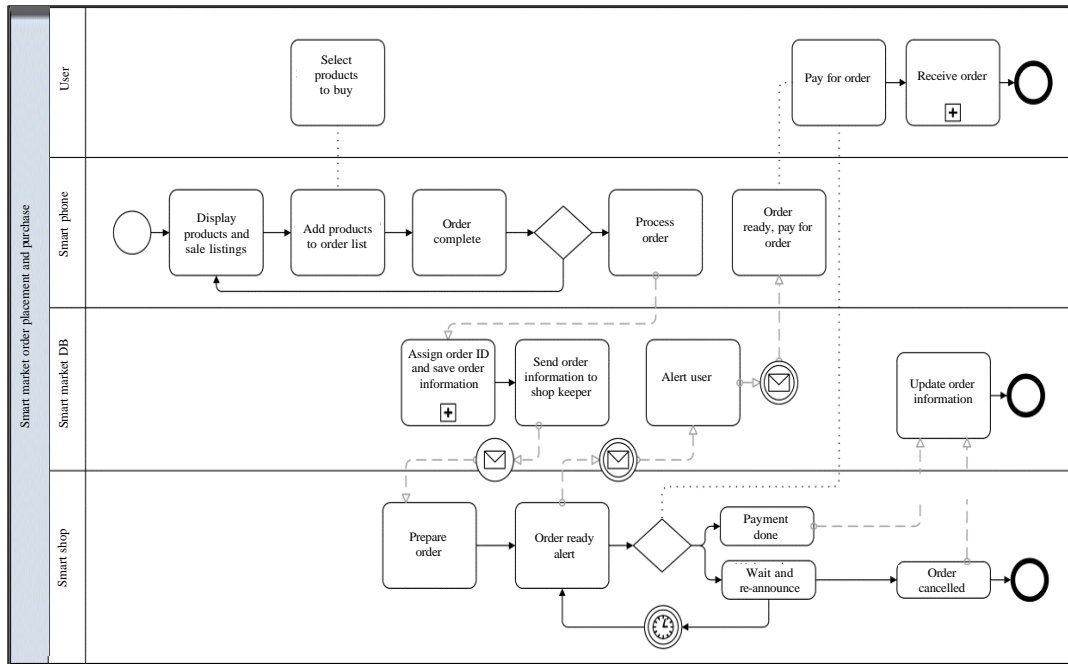


Fig. 10: Business process model for order placement and purchase

The user then visualizes the information sent on his/her smart phone. This data can be presented to user in the form of lists of items on one or more screens. The user may then utilize the smart phone controls to navigate the lists or screens and get more information regarding the items of their choice.

Figure 10 presents the business process model for order placement procedure in the smart market scenario. This process can only take place if the user has already received the catalog and/or sales promotion data from the smart market based on push or pull service. In the previous BPM models we have illustrated how the user can receive the catalog and sale promotions in a smart market. Once the user can visualize the catalog and product sale information using his/her smart phone then he/she may select the items which can be presented to the user as list of items. The user may then select the items which he/she desire to purchase and add the items to an order list. Once the user has selected all the items that are needed to be purchased, the user will request for the processing of the order using the smart phone interface. The order information is sent to the smart market where the order information is saved and proper identifier is assigned to the order. The identifier is then sent back to the user and the order information along with the order identifier is sent to the smart shop or point of sale. At the smart shop, the sale person prepares the order based on the order information sent from the smart market. When

the order is ready, the identifier for the order is announced. The user pays for the order and then the information in the smart market database is updated with purchase completion event. If the user does not pay after the announcement of the ready order, the order is re-announced at a specified time interval. The process is repeated for a pre-defined number before the order is termed as cancelled.

Smart market also provides the user with the facility of reviewing all his/her shopping history at a later time. This facility enables the user to review his/her expenditures on shopping and adjust budgets accordingly or may be used to compare the users shopping expenditures at different times. Figure 11 illustrates the business process model for the smart market customer shopping history review process. In order to retrieve previous shopping information from the smart market, the user must be using the smart market application. The user launches the application and logs in through his/her certificate or login identifier. The application validates the user by sending his/her credentials to the smart market database. If the user successfully logs in to the system, the user activity interface is loaded by the smart phone application. From the interface the user selects the review activity and may choose options such as product based review or time based review of all the previous shopping that he/she had in the smart market. The smart market database is queried

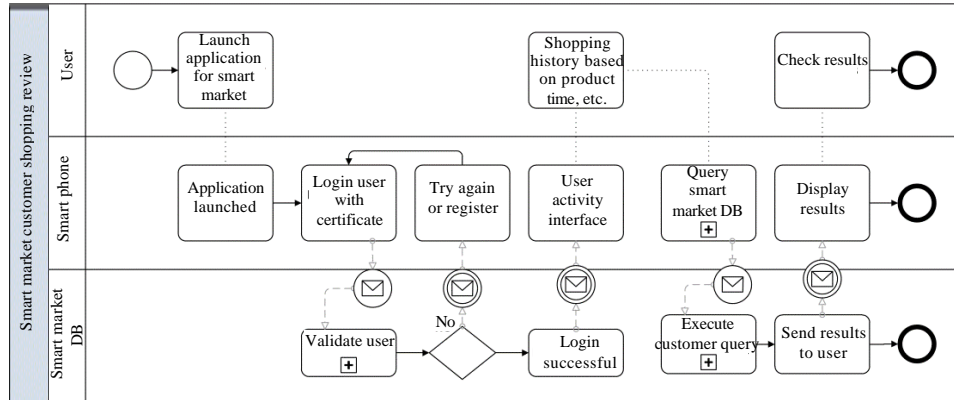


Fig. 11: Business process model for shopping history review

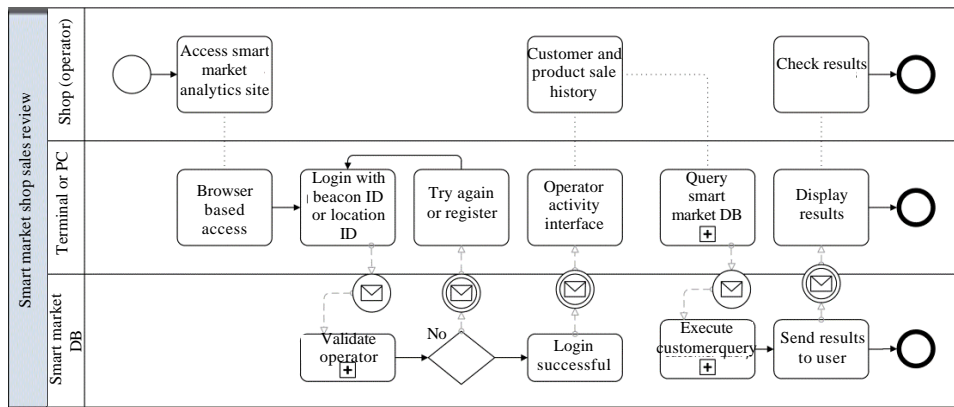


Fig. 12: Business process model for sales review

based on the options selected by the user and the result of the query is sent to the user's smart phone. The application then displays the data sent by the smart market to be viewed by the user.

As the user in the proposed smart market system can review the previous shopping history, the same facility is available to the shop salesperson or operator as well. The operator may review the sales trends with respect to time of the year, sales based on the promotions and discounts and customer interests in various product types. Such information may also be used for future advertisements and promotions using the smart market. Figure 12 illustrates the business process model for the smart market sales history review process. The salesperson or the data entry operator at the smart shop can login to the smart market central site which could be a web site or a dedicated server. Again, the access to this system may be granted through a common web browser or dedicated client application. The operator at a specific shop may use their unique certificate or location identifier to login to the

system. At successful login, the operator activity interface is loaded, through which the operator can visualize various options related to the sales history from the perspective of customers, products promotions. This information can be used to identify the trends in product sales based on time of the year, months or even days of week. Similarly, the sales trends based on promotions and advertisements can also be monitored.

CONCLUSION

This study proposes a smart market system for easy and efficient shopping at market places. The user of the proposed model while passing through the market is able to get dynamic information regarding shops and product catalogs along with information about promotional sales and advertisements via their smartphones. They do not need to search for products. They can have complete information about a product can easily compare prices from different shops and purchase products easily and efficiently. The proposed model offers review and

analysis services for both customer and seller thus increasing the efficiency and productivity of both entities. Further researchers intend to implement a prototype for the proposed model based on current Internet of things technologies.

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