Cloud-based mobile commerce for grocery purchasing in developing countries

The increased prevalence of mobile devices in developing countries, for example in Brazil, Russia, India, and China (BRIC countries), provides a significant opportunity to transform the grocery purchasing experience. In these countries, the grocery buying experience has been a routine chore in which the customer often interacts with a familiar local grocer. The goal of this paper is to propose using feature phones and smartphones for grocery purchasing from small-sized to medium-sized grocers in developing countries. The platform will use a cognitive module to process incomplete or partial shopping lists to provide an assisted shopping experience. The paper proposes using cloud capabilities to deliver such a cost-effective mobile commerce experience for grocery shopping.

Introduction

The retail industry is experiencing growth and opportunity in areas that are led and transformed by the evolution of multi-channel retailing, such as electronic commerce, mobile commerce, brick-and-mortar stores, and so on. In this paper, we explore the impact of the widespread adoption of mobile devices on grocery purchases in developing countries. We identify the need for a disruptive cloud-based platform that is cognitive and socially “aware” and that enables mobile commerce (mCommerce) for grocery purchasing in emerging markets. As explained later in this paper, we use the term “cognitive” simply to suggest that the recommendation engine should use natural language processing to analyze incomplete grocery lists and machine learning to continuously improve the quality of its suggestions to customers. Such a system will then more effectively serve the customers, similar to their familiar local grocer. The consumers in such markets are being exposed to large hypermarkets and supermarkets that provide a wide range of choice for groceries. For example, they provide enhanced services like home delivery and provide web sites and a call center for ordering. This has increased the consumer’s expectations. Traditional grocers in these markets may not be able to invest individually in such technological platforms, but they realize that there is a transformation in consumer expectations. They require a platform with which they can better compete and serve their customers. These competitive pressures make subscription to such a mobile shopping platform for groceries attractive to grocers. Consumers will also be able to renew their relationships with their familiar local grocers and benefit from the enhanced service levels. These competitive pressures make it profitable to provide and support such a platform for an information technology (IT) vendor.

This position paper presents our vision of important technological shifts with respect to cloud-based mobile commerce for grocery purchasing in developing countries, and although our complete system remains to be created, we are beginning to create prototypes of important elements of the system. In particular, we are developing prototypes of the grocery recommendation engine and a text server that present mobile content on feature phones, which are phones that are only capable of making phone calls and supporting short message services (SMS). We have implemented portions of this platform at large grocers in the United States and Europe.

Our preliminary investigations indicate that the mobile penetration, as well as interaction between consumers and local grocers, in other developing countries (Brazil, Russia, India, and China [BRIC]) is similar to the Indian market.
The approach presented in this paper is extensible to
developed countries. The proposed approach has simplified
interactions in areas such as real-time inventory tracking
at stores, payment processing options, and pricing and
promotion offerings and does not handle capacity tracking
for the delivery network. These aspects should be addressed
to tailor the platform for advanced countries. Grocery
shopping on mobile phones is usually not prevalent even in
advanced countries, and, therefore, such a platform will
promote usage of the mobile channel for grocers in these
economies.

We start by listing some related prior work. For example,
researchers have analyzed various approaches to enable
mobile commerce for grocery purchasing and to study its
impact on consumers. Childs, in the Food Marketing
Institute’s Research Report 2013 [1], has explored the
potential of grocery shopping applications and their
impact on the consumer’s grocery shopping experience.
Heinrichs et al. [2], in their Association for Computing
Machinery (ACM) publication “The hybrid shopping list:
bridging the gap between physical and digital shopping
lists,” have explored the transition from paper-based lists to
digital shopping lists. They also explore the design and
implementation of a hybrid list that uses a pen-and-paper
user interface on a mobile phone. There has also been work
over the past few years toward technology-assisted shopping
lists compilation, based on behavior. Mattila, in his
patents “A method for creating computer generated shopping
list” [3] and “Arrangement for facilitating shopping and
related method” [4], applies data mining and collaborative
analytics to generate a shopping list. In another patent,
Nofliza et al. [5] present an engine that is based on the
“reasoning process on the user’s purchasing behavior model
and based on the user’s current context.” Letham et al. [6]
use an example of an online grocery store recommender
system for their sequential event prediction algorithm.
They fit the sequential prediction model to the shopping list
which is typically an unordered list, in order to predict the
next item added to the basket [6].

The approach of delivering mobile applications using
SMS technology has been studied and proposed by
Wei-Chih et al. [7]. Other open-source platforms, such as
Kannel, exist that can be used to develop such an interaction
[8]. RapidSMS [9] is an alternate platform for development
of the SMS interface, on which a number of mobile
applications have been built.

An approach for a hosted inventory management system
that tracks retailer merchandise has been described by
Grmek et al. [10]. Christensen [11] has researched
service-oriented architectures (SOAs) for exposing RESTful
web services (where REST denotes representational state
transfer) to enable mobile applications.

If we consider the Indian market grocery retail sector for
2013, the estimated revenue was $409 billion. This sector is
expected to reach $566 billion by 2016 [12]. Sinha et al. [13],
in their research “Format Choice of Food and Grocery
Retailer,” present the retail formats in India. The grocery
sector is anticipated to undergo explosive growth in the
organized sector. This sector has various kinds of stores,
such as small stores, supermarkets, and hypermarkets. These
types of stores vary in terms of the stock keeping units
(SKUs) they carry, size of store, pricing, service levels,
ambience, and accessibility.

India has the second largest number of mobile telephone
users in the world, with approximately 862 million users.
The smartphone penetration in India is only 6% of the total
mobile subscriber base. There are 67 million smartphone
users, and this number is growing at about 50% each year
[14]. The mobile commerce applications will need to
extend their reach using text messaging platforms like SMS
in order to be adopted widely. Given the prevalence and
affordability of mobile phones, mCommerce is poised to
overtake electronic commerce (eCommerce) in India, as
there are only about 150 million users with access to the
Internet [15]. The delivery of services using SMS extends the
reach of the service to the vast majority of consumers in
such emerging markets and is therefore a key consideration
for such a platform.

There is a need for further study on the impact of grocery
purchasing using mobile phones in such emerging markets.
The positive impact of engaging customers across
channels has been studied and reported [16] in United
Kingdom. This work has shown that customers who
interacted with retailers using both the websites and
mobile phones have spent up to eight times more than a
customer who only shopped at a store. There have also been
studies in the United States that have focused on the
impact of online shopping trends, and such studies indicate
that online [17] and mobile channels are likely to become
more common place for grocery shopping. We believe
that these trends will also be observed in emerging markets
where mobile phones have become commonplace. There are
grocery delivery websites such as Peapod** and Amazon
Fresh** that have had success delivering groceries in
United States. They have proven the viability of grocery
shopping using mobile devices [18].

For this paper, we researched the Indian grocery market
and mCommerce in India. We analyzed the grocery
buying experiences of consumers as well as retailing
practices of grocers. The likelihood of consumer adoption for
purchasing and tracking grocery orders using mobile devices
is high, if a personalized interaction were to be available.
This personalized interaction should match the level of
personalized interaction that occurs when shopping with
local grocers at present. Through this channel, the grocers
will also benefit by retaining and adding new customers
through better customer experience, enhanced analytics, and
social endorsement. As we noted, the grocery buying
experience has been a routine chore in which the customer interacts with a familiar local grocer. This involves making a grocery list that often references the merchandise without naming a brand. The trusted grocer would then identify the appropriate brand based on customer preferences and past experiences with that customer. The introduction of global retailers into this market, offering a wide range of channels including mobile devices, has increased the level of expectations for customer service. For small shops and supermarkets to offer this increased level of experience, there is a need for a cloud-based platform that enables mCommerce for these grocers. It is critical that such a platform preserves the specialized knowledge that local grocers carry by offering cognitive recommendations for grocery purchases. The platform thus reconnects, using the mobile channel, the familiar local grocer with whom consumers have strong relationships.

The platform will need to be cloud-based to be cost effective, support quick onboarding, work with retailer stores assuming no extensive change to technical infrastructure beyond a high-speed Internet connection, and provide a portal for retailers to maintain their key information. The key information includes details about customers, inventory, and orders. It will support workflows for customer registration and order capture, provide visibility into the fulfillment lifecycle, and, most importantly, it will support such workflows using both smartphones and feature phones. The platform will handle authentication, authorization, privacy, and security considerations. The following sections outline the proposed interaction between the consumers and grocers, the technical solution to address this interaction, and a proposal on how the IBM Smarter Commerce* [19] suite could be utilized to offer such a solution. It also covers other areas for further exploration and research.

**Proposed paradigm for grocer-customer interaction using mCommerce**

The proposed interaction between a customer and the grocery retailer using a mobile device is shown in Figure 1. The anticipated sequence of interactions is described in the following paragraphs.

To place an order, a customer should be registered with the grocer. An unregistered customer who wishes to use the

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**Figure 1**

Proposed workflow for enabling grocery fulfillment using mobile phones.
services will be asked to authenticate via a text or a phone call, and the necessary details will be collected. The registration process provides a simplified mechanism to obtain customer information like name, address, zip codes, location, phone numbers, email, and landmark. This can also be used to gather a client’s preferences such as preferred delivery window, mode of payment, and communication preferences.

The grocery list can be typed into the mobile application or a photograph of the handwritten list can be sent via the mobile application using text or media-based messaging services (MMS). This list will be parsed to create a structured grocery item list and fed into the recommendation engine. The cognitive engine considers factors such as inventory availability, historical brand preferences, price sensitivity, and social feedback. It then performs analytics to provide a processed grocery list with associated SKU, brand, and price. The engine will combine both collaborative filtering and content-based filtering to provide effective recommendations. The content-based filtering uses user history and an understanding of user behavior based on product features. The collaborative filtering considers brand selection and uses peer data and properties (like demography) to alter the data and ratings.

This order list and supported delivery window is returned to the customer with the total cost, requesting confirmation of the order via a push notification to the mobile or an SMS if it meets the ordering prerequisites. The customer will confirm, modify, or decide to reject the order using an SMS or the mobile application. In the case of a rejected order, it will route through an exception route, and a call-center executive will call the customer for clarification. The system will then place the customer’s order in the order management system.

The order management system will create an order and send it to the appropriate grocer’s store for fulfillment using an email message. Real-time checking of inventory will not be performed, and any shortages beyond this stage will be dealt with through operational means. The grocer “picks” the merchandise and confirms that the merchandise is ready for delivery. The cognitive engine will detect unexpected out-of-stock situations, consider these out-of-stock situations, and consider customer preferences regarding substitution when making suggestions for items that should be on an order. This pick confirmation will be a notification that is pushed to the customer’s mobile device via SMS or other messaging systems, providing visibility into the grocer’s fulfillment process.

The grocer may also define the street mileage up to which such a delivery service is supported. The solution will allow retailers to specify a delivery time offset. The merchandise is expected to be deliverable after this defined offset period. Our analysis of the delivery network in the Indian market indicates that grocers can easily expand delivery capacity by employing additional delivery agents and delivery vehicles, like a moped or a bicycle. Therefore, we do not believe tracking delivery capacity and planning delivery routes are crucial aspects to address in the context of the Indian market. The capacity to perform such deliveries will be managed through operational measures. The grocer will provide a batch inventory feed to the platform. This batch feed of supply data
can be accepted multiple times a day, and the grocer will provide only the amount of merchandise for every item that is saleable using the mobile channel. Thus, the grocer controls the “safety stock” and avoids over-promising to the mobile channel. The system will continuously track the demand placed through the mobile channel and compute the inventory availability for a given item.

The grocer’s delivery service will deliver the merchandise to the customer. The grocer will update the order state as “delivered” and collect the payment. The payment will be collected using credit card readers or cash or check by the grocer’s delivery network. This completes the transaction using the mobile application or via SMS. This delivery confirmation will then trigger a push notification to the customer and request the customer’s feedback on the experience with the retailer. The customer will also have an option to update the feedback using popular social media. The customer’s feedback will be fed back into the cognitive engine.

The proposed mCommerce cloud platform, which is designed in the context of developing markets, provides an avenue for grocers to compete with larger stores and retain consumers by offering higher levels of convenience and service. The onboarding procedure to this cloud platform will include data loads for catalogs, prices, inventory, and delivery windows. The grocer will provide the product availability and inventory status on a scheduled basis every day. The grocer will also send the promotional data to the customers using text messaging.

The components that are required to deliver the cloud-based mobile platform for grocery are shown in Figure 2. The content delivery system (CDS) manages the delivery of the solution to a smartphone, feature phone, and browser. The CDS manages notifications to customers using the preferred communication method. The cognitive recommendation engine translates incomplete requirements from customers into specific products. The social plug-in integrates with social platforms to publish customer feedback. The order management system sends fulfillment instructions to the grocer’s system and tracks the order’s lifecycle to completion. The call center system will be
used by the call center agents who handle exceptions and modifications to the order. All hosted systems feed their data into analytical systems that allow collating and analyzing trends. The solution suite will be hosted on a scalable platform that can easily expand to support the incoming traffic.

**Mapping to the IBM Smarter Commerce software suite**

The proposed architecture using the IBM Smarter Commerce suite of products is shown in Figure 3. IBM Worklight* [20] provides a platform to develop, run, and manage smartphone and tablet applications. The Worklight shell allows developers to build applications using open standards without knowledge of each smartphone platform’s native development language. The system additionally supports real-time analytics and control of mobile applications and their infrastructure.

The text or SMS server is a custom component that shall integrate and serve the mobile webpage content via SMS. This server will integrate with a text messaging platform, such as Kannel, to serve the pages via SMS. This integration is one of the key differentiators with this solution. The presence of the SMS engine that translates smart pages into SMS will allow reaching out to feature phones, which are used as the majority of mobile devices in the developing countries.

The recommendation engine will require a cognitive platform. We propose to use the ecosystem and capabilities of IBM Watson, a natural language processing (NLP) system, to develop the cognitive engine for the grocery market.

The eCommerce portal and business logic will be delivered using the IBM WebSphere* Commerce [21] platform. WebSphere Commerce delivers a seamless, omni-channel shopping experience through contextually relevant content, and marketing and promotions, while extending across digital and physical channels. The inventory status for grocery items will be published to IBM WebSphere Commerce using the inventory availability monitor in IBM Sterling Order Management [22]. IBM Sterling Order Management provides a centralized-inventory order-processing and fulfillment hub to support omni-channel fulfillment. It helps enterprises increase fill rates and inventory turns, reduce markdowns, improve customer loyalty, and increase wallet share. During the order purchase lifecycle, the inventory will be reserved, to avoid over promise. IBM WebSphere Commerce will integrate with the payment platform and create a grocery order that is then transferred to IBM Sterling Order Management. Coupons and promotions will be managed using IBM Sterling Order Management.

Information from the various software platforms is continuously fed into an analytical database managed by IBM Cognos* [23]. This allows for a rich reporting suite, which is then made available to the grocer to study key metrics of order capture, fulfillment, and customer satisfaction.

This Smarter Commerce suite of products is already available as a service on the cloud. IBM SoftLayer** [24] can be leveraged to set up and manage the entire platform. SoftLayer is a self-service, high-performance infrastructure-as-a-service offering from IBM for the most demanding cloud applications.

**Conclusion**

The grocers in developing countries often provide a personalized shopping experience to address the chore of grocery shopping. The widespread adoption of mobile devices provides an opportunity to transform grocery shopping. The platform and technology outlined in this paper has a high potential to favorably disrupt the grocery market using the mobile device. This enhances the shopping experience for the customer. The application of new trends in technology will help the grocers in the developing nations move to the new era of commerce.

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**References**


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