



Review Paper

Cloud-Based Shared Food Ordering System with Context Awareness: A Location Base Services Approach

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Available online at: www.isca.in, www.isca.me

Received 10th February 2013, revised 27th March 2013, accepted 3rd May 2013

Abstract

Mobile Marketing and Location Based Services is no longer somewhat people just talk about. Location-based services (LBSs) are increasingly popular day by day. LBS provide personalized service to Smartphone/tablet users by exposing users' location information. These services may be offered on request, such as a list of nearest ATM machines, amusement parks, beaches, hospitals, restaurants, shopping malls or gas stations etc. these services gives advantage to delivered automatically when a certain event occur. It has been proved by the research that the most popular location user searches, are restaurants and stores users search for, followed by local attractions and locations associated with leisure time. Many applications exist for ordering food on-the-go, but most of them maintain their own databases for restaurant menus and provide no or little support for a "Joint-Order". This paper answers both questions by giving architecture with integration of third-party operated menu database (OpenMenu), and innovates a "Shared Food Basket" concept. By using Open Menu, restaurants can maintain their menus at one place, and use it everywhere, hence reducing the need for updating same menu at several places. A shared food basket is a new concept, which has capability to select menu items by multiple users, but only one of them can place it as order. The presented cloud computing approach positively minimizes the time taken to process an order, when a group of friends meet at lunch/ dinner. This research provides context-awareness model with mobile functions integration for food industry. This model tends to be cost-effective and ubiquitous access, the architecture fit into a cloud approach.

Keywords: Location-based services, food industry, cloud computing, context awareness, ubiquitous computing, food ordering system, shared food basket.

Introduction

Ubiquity is the state of being everywhere at once. Ubiquitous computing is an emerging field that emphasizes on 3C (computation, context, content) everywhere at any time. The environment involves heterogeneous wireless/wired devices and sensors everywhere; making computing devices smarter and available throughout the physical environment, while keeping them effectively invisible to the user. Context awareness is a part of ubiquitous environment and it means that ubiquitous computing system is aware of its user's state and surroundings and is able to modify its behaviour based on user's information. These intelligent devices integrate and communicate with each other in the background and behave as one, to make smart environment. Smart environments will assist users to make better choices as they go about their everyday lives.

Ubiquity or ubiquitous computing involves mobility, invisibility, scalability and localization; integrating these technologies with context awareness and adaptability, results in smarter devices. The concept of 'quick access to relevant information anywhere at any time' is incomplete without involving context awareness and location-based services (LBS). Ubiquitous computing applications are increasingly leveraging

contextual information from several sources to provide users with behavior appropriate to the environment in which they reside These LBS are making life easier as they most useful for people on-the-go. When the user's contextual information is extracted by a system then some sort of computation or action must be taken place against that information. Therefore it can be said that ubiquitous computing and LBS are complementary to each other. On the other hand, cloud computing infrastructures are increasingly being utilized by the organizations to manage their resources. Cloud computing infrastructures use common programming models to simplify application deployment & management, empower applications and services with intelligence and integrate existing IT assets. Nowadays location-based services are placed on the cloud infrastructure to realize the real ubiquitous networks with LBS support. It can be said that integration of ubiquitous computing and location-based services on cloud provides ubiquitous environment where every object is smart and communicating.

Cloud Computing

There were times, when organizations kept all their data and operations in-house, i.e., running and maintaining all the services and computerized resources locally, where all the

responsibility lies upon the IT Department. Resources were available to users, only, when they are on their systems, or they need to login to a private network (operated through company), and to run all these operations successfully with minimal risk, organizations needed large investments to build their infrastructures. Now the trend is shifting towards an environment, where resources are always available to end-users without the fear of data loss, and where IT department is no more responsible for maintaining services, making replicas of data and so on. This shift is known as "Cloud Computing". There is more to cloud computing than just a third party operated network.

Cloud Computing is different styles of computation over internet, or a service running over a remote complex network with high bandwidth and massive storage servers, whose configuration, installation, updation and maintenance is done seamlessly by a third person. A cloud, itself can be seen as a software, a data storage place, a platform (where new applications can be developed) or the whole network. Zheng 2010 suggested that computation is a virtual pool of resources in cloud computing and this virtual pool is accessible through internet for end users. Brian 2008 also suggested a similar idea, that, it is about moving services, computation or data to an external or internal, location-transparent, centralized facility for business advantage.

Cloud Computing has a broad applicability from online softwares to an externally deployed infrastructure. Its different flavors and shapes have been discussed by Brian¹, Zhang² and Aaron³. At very core, cloud can take three basic forms: Software as a Service, Platform as a Service and Infrastructure as a Service.

A cloud may provide a software service, i.e., internet-based software that is accessible to end users only via a web browser, commonly known as SAAS (Software as a Service). From a user's point of view, SAAS has replaced the need for setting up an environment (where the software can be run), installing the software and regularly updating that software product. From a vendor's viewpoint, an online software (service) can be developed and tested in a "vendor's choice" platform, also issues related to maintenance, i.e., updates and bug fixes can be deployed in minutes¹. Common examples of SAAS are Google Docs by Google and Photoshop Express by Adobe.

Through Platform as a Service, developers can develop their own application programs using the environment of someone else², hence, no software crashes fear or software conflicts, that are very important in a development environment. Google application Engine is a common example.

Moving all the computation and/or storage to a cloud is referred to as Infrastructure as a Service^{1,3}. Here computation is delivered like electricity and users are billed for the cost of cycles used³. As an example, Amazon Web Services offers data

storage priced by the gigabyte-month and computing capacity by the CPU hour¹.

Advance use of Cloud Computing: With the increased use of cloud computing, people are moving their businesses to it, especially, for money-saving and scalability advantages. Recently, a Pharmaceutical company wanted to run a virtual screening of 21 million chemical compounds (Foodservice.)⁴. The whole job was done within three hours with less than \$15,000 with cloud computing support, and if they had tried to do it in-house then they would have had to spend millions, and the job would take years to complete. Lizetta⁵ is a case study of an IT management and support company that was, recently, looking for a responsive and reliable email hosting provider. Their email servers were already running at a hosting company but they were not satisfied with the quality of service, the hosting company was providing. So, when they heard about cloud email services, they immediately switched all the emails, their own and their customer's, to a well-known cloud service provider. Now they are happy with the quality of support and service.

Food Industry and Cloud Computing: Cloud Computing is playing a very active role in food industry in many areas, for example, Customer Relationship Management, Customer Service and Supply Chain Management to name a few. Lara⁶ mentioned that food service providers, now, want to ensure that they have the right product in the right place at the right time, and thanks to cloud computing for connecting people and companies in real-time and for making food service provider's life easier. She also mentioned a case study where a food manufacturer reallocated all its products when a supplier's plant got down. With their system running over cloud, they didn't have to short a single restaurant in their network. This would be difficult without the cloud support. Another UK-Based reservation provider, Livebookings, improved the method; a restaurant interacts with its customers, by using cloud computing (Chris 2011)⁷. The CEO of the company believes that now restaurateurs can create instant promotions night-on-night and can properly analyze the reasons people book their tables. Also Cloud hosted services can make it easier for diners to book tables at the last minute.

Location Based Services and Ubiquity

Location Based Services are becoming vital part of everyone's life. As smart phones are getting cheaper, they have become common and easily available within the reach of a common man. Through smart phones one can use location based services in daily life, for example, searching a gas station, or knowing directions to reach a particular place, or to find a restaurant at nearby or some specific location. The idea presented in this paper focuses on providing an LBS based architecture that innovates the idea of ordering food on-the-go. Although many applications exist for same purpose, but they lack shared order facility, and also all operate their own databases for keeping restaurant menus. In this architecture both the weaknesses have

been addressed and overcome. Key features of this approach include ubiquity, cloud-based architecture, location-awareness, content relevance and usability.

Ubiquity is the state of being everywhere at once. Ubiquitous computing is an emerging field that involves heterogeneous wireless/wired devices and sensors, making computing devices smarter and available throughout the physical environment, while keeping them effectively invisible to the user. Context awareness is a part of ubiquitous environment and it means that a system is aware of its user's environment and is able to modify its behaviour based on user's information. Cloud Computing is different styles of computation over internet, or a service running over a remote complex network with high bandwidth and massive storage servers, This architecture provides all the key benefits – cost effectiveness, ubiquitous access, and uninterrupted service etc. - associated with a cloud, by placing all the core services in a cloud.

Ubiquitous computing applications are increasingly leveraging contextual information from several sources to provide users with behaviour appropriate to the environment in which they reside. On the other hand, cloud computing infrastructures are increasingly being utilized by the organizations to manage their resources and hence empower applications and services with intelligence and integrate existing IT assets. Integration of ubiquitous computing and location-based services on cloud provides ubiquitous environment where every object is smart and communicating.

Critical Success Factor for LBS: Future LBS applications could integrate communications between multiple users, such as the capability to find nearby users and to geocast messages to many users at once⁸. Finally, they can make use of sensors available in smart phones such as cameras and accelerometers, to provide extra information that can be fed into a cloud of location-tagged information: This is significant regarding collaborative LBSs as it reduces manual data entry, which can make the application more engaging⁹⁻¹¹.

Typically, the mobile operators have been at the vanguard of offering any new service to its subscribers as they have had control over the network as well as the consumer¹². They have direct access to the subscriber due to their billing capability. Not any speculate, they considered offering location based services as their basic right and hence refused to share the location data with other entities. At the same time, they did not have the resources to spotlight on this services and the mindset required to be successful in this business was also missing. Over a period of time, the other entities developed ways of by-passing the operators (e.g. Google, Skyhook, etc.) and started to offer services without the operator role. Increasing penetration of GPS devices is also taking away the role of operators and hence we are now seeing some traction rebuilding in this space. Higher data cost has been another limitation for low penetration of LBS. Mobile internet is the basic feature to serve the location based services and high cost of mobile internet lower the

adoption capability of mobile internet. Another issue is the absence of proper business model and the monetization of LBS. It is extremely hard to maintain the high costs involved in getting the location data without charging a high fee for the services.

Contextual Issues in LBS: Context management has become a hot research issue. Significant contributions include the COMPASS (Context-aware Mobile Personal Assistant) mobile tourist application which uses the context to provide relevant business services (like restaurants, museums, shops, cinemas, etc) to the user. In the COSS (Context-aware, Ontology-based, Semantic Service discovery) system service providers and context providers use domain-specific ontologies to which they commit¹³.

Everything is context-dependent, in particular the meaning of the terms that appear in user's requests or in service and data descriptions¹³. One of the pieces of information that has the most potential is location. That's because, once this is known, there are so many other pieces of data that can be inferred contextually. Contexts in LBS group any information that characterizes the situation of a person, place, or object, as well as the meaning of things at hand, and that can be used to provide more relevant services to the user. LBS contextual information typically includes the user's location, the time, the weather, the traffic conditions, etc.

The fastest and modern medium of broadcasting personal or business information and applications to a wide variety of end-user across public or private networks is through their mobile devices.

Content sharing is playing a vital role in almost every field. However one cannot deny the fact of privacy issues while taking about the distribution of content on Web. For example, over social networking websites people share lots of personal and sensitive content in the form of text, video, audio or images which need to be highly protected to build consumers' trust. LBS provide personalized services to Smartphone/tablet users by exposing users' location information. However, LBSs also pose a serious danger to users' privacy. By collecting the location information embedded in the LBS queries, an adversary, who has compromised the LBS server, can infer critical privacy information about service recipients, such as their office or home locations, health issues, political/religious interests, associations and daily lifestyle activities¹⁴.

LBS in Food Industry Context

Location based services are widely used these days in mobile device to locate user and to know about user's current state and activity and to get user preferences. These services may be offered on request, such as a list of nearest ATM machines, amusement parks, beaches, hospitals, restaurants, shopping malls or gas stations etc. It has been proved by research that the most popular location user searches for, are restaurants and stores, followed by local attractions and locations associated

with leisure time. For example, a restaurant using mobile location based marketing service could offer consumers within one mile of their location a special luncheon deal.

Nowadays most of the people use internet to order food online. Generally in big cities, people prefer online food ordering systems rather than going restaurants, especially in metro areas where people eat out nearly one-fourth the time. Ordering Pizza online is almost like a current food tradition. As computer technology continues to emerge, foodservice professionals are faced with new possibilities for information management. The internet has changed the business strategies and the way companies do business. Now the issues are integrating applications, adapting technological tools and improving usability in order to achieve business objectives.

Food industry experts are recognizing the profit of online ordering, the moving technology that can increase a restaurant business. Online ordering can impact food business in many ways, for example, it can enhance operational effectiveness that is enhancing a restaurant's profitability, increasing efficiency and helping employees focus on more important tasks. It also helps hardening the connection between restaurant and customer by giving permanent and repeat customers. Owners of restaurants can increase their productivity and quality of service by using the technologies that are adopting in different fields.

Use of mobile technology for restaurant /food industry can be beneficial for the owners of the industry in such a way that a customer can place order from any location with their hand-held devices, this could increase sales of the restaurant industry in an effective manner¹⁵. There will be no issue of time and distance.

While adopting a technology based service for a restaurant business, the owners must consider the benefits and costs of the technology and also the customer satisfaction level and reaction because if that technology dissatisfied a customer, it means it is not good, no matter how much it reduces labour costs¹⁶.

The modern development in the restaurant industry by using mobile devices provides a viable advantage for business growth. The approach could be followed by the ways like sending menu to a person through email, sending advertisements and special discount to a person cell phones, providing map to locate a restaurant in any location, providing interface and food related images, updating new arrival of restaurant menu items, providing free coupons and trial offers and many other options.

More restaurant chains are embracing location-based technology¹⁷. For speedy service with exactness and quality control, many fast food restaurant chains have adopted location based services for the mobile users for their food ordering systems.

FoodPal

Many early researches have been made by using wireless technology and smart phones in food ordering system implementations. Previously proposed and implemented food ordering systems exhibit limitations. There are systems available for food ordering through wireless devices but what you can do if you need to ask choices from more than one person. For example; if you are going to invite a group of people then you have to wait for their arrival then you will place the order.

It is always a cumbersome task to gather a group of friends or call a meeting over a lunch/dinner, as we all have different engagements and we might get late to reach somewhere. In order to minimize the hassle of ordering and gathering of people, we proposed a solution. Our proposed solution will help smart phone (figure 1) users to locate the restaurant, create and submit the order before reaching to the place, it will save their time.



Figure-1
FoodPal Abstraction View

In conventional food ordering system, you and all the guests have to be at the restaurant, waiters are required to note the orders then they will submit your order to the kitchen and it all takes lot of time. In our suggested model, a Master (owner of basket) initiates the order by using the LBS and tracks the nearby restaurants. Location Based Service will provide the nearest restaurants to the Master. After selecting the restaurant, Master will send the application request to the friends (slaves). F1, F2 and F3 will receive the notification of the order application; they will extract the menu of the particular restaurant through OpenMenu, which will be placed on a cloud. After selecting the particular items, Slaves will deposit the order to the basket of Master. After receiving all 3 orders in the basket, Master will submit the order to the Ordering System, placed on cloud. Restaurant will receive the order through Ordering System on Cloud, and processes the order.

This way not only saves the time but also increase the efficiency, usability. Food ordering in a group through a basket would be a swift service with ease of use. The placement of

OpenMenu and Ordering System on a cloud helps all involved parties to communicate with each other without any server or registration requirement. Master, Slaves and Restaurants all just need to access the cloud in order to process the overall food ordering system through a shared basket.

Processes of FoodPal: Anyone can use FoodPal application from his/ her smartphone like iPhone or BlackBerry. FoodPal users can search for the nearby restaurant according to his/ her preferences – These may include seafood, fast food, Chinese, Traditional food etc. - application in response will return a list of restaurants. Within FoodPal, order initiator is termed as “Master User”, who is responsible for creating new order (as shared basket), to send requests to multiple users (from cell phone contact list) to join that order, and to finally submit the completed order. Here participating users (other than Master) will be notified through an SMS about their invitation in the order. All the users here will share the same restaurant menu made available through OpenMenu¹⁸. Participating users will select and send the menu items of their choice to Master, who will further confirm it by choosing a “Confirm Order” option. FoodPal will then forward the submitted order to restaurant in one of the various ways, including sms, email or web service (if exposed by food providers). Please note that this application does not handle order payment and delivery.

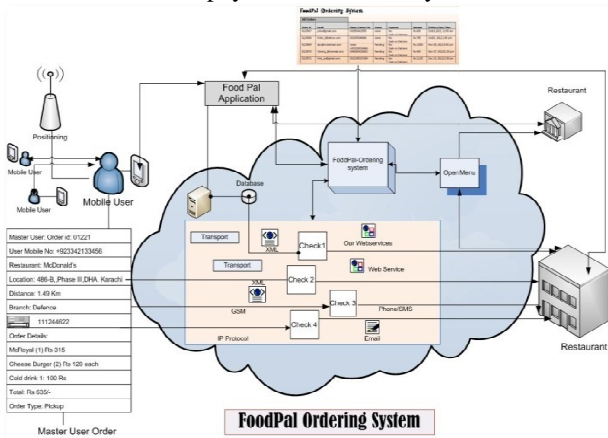


Figure-2
Work Flow of FoodPal Ordering System

Work flow of FoodPal Ordering system is shown in figure 2. The intent of this research is to introduce the idea of master user basket. Application will check first the food provider near to his location. The list will be shown according to the nearest food provider.

Another way is user will give the location to the application that he will be there in an hour so find out the nearest restaurant of that particular location. It means user will be providing the address of the location.

Moreover an application sort out results according to the user favourite and most visited restaurants who are using location

based services, for example KFC is on the top of most visited list of food chains and then Pizza hut, hence results will show the list, in which KFC will be on top and Pizza hut on second. This all data of restaurant list will be coming from a food provider. The results will be shown according to the user id of every individual user.

FoodPal Elements: There are so many features of mobile food ordering system. We have highlighted the features which are available in our FoodPal mobile application. i. FoodPal allow customers to order from iPhone, iPad, Android, and all other smartphones, ii. Notifications made via phone, sms email or to the restaurant system using web services, iii. Online food ordering widget available to place on restaurant website, iv. Customize currency, takeout / delivery, delivery fee, delivery radius, free delivery, convenience fee, times in which they can order, tax, and more. v. Payment will be taken on Cash.

Master User Concept for FoodPal: The idea behind using a Master user is to introduce a food bucket. Master user will be the owner of food order who will initiate order and invite other to order menu.

The advantage of using master user is to cut down the time of sending individual orders by all the users and to save restaurant database by prompting again and again for the order by every individual user. Master user has full right to choose restaurant according to his wish.

Master user selects a restaurant from a provided list according to his nearest location and will initiate a request in which he will include all his fellows. The popup will generate to the all the users that master user, for example Alian has initiated a food order request. Now all users who are added in the food order list will select menu from the given restaurant available menu.

User after confirming from all the added users will then be submitted to master user. After receiving order from all the fellow users, master user will confirm the food bucket and send to the food service provider. Now food service provider will receive an order list from a master user side. User profiling will be done on user's smart phone.

Customer and Restaurant owners both can get benefits with Foodpal mobile food ordering application. Customers can make an order directly from his/her mobile at anytime and anywhere. They can easily find and select restaurant locations and choose the preferred time for pick-up. No need to go into the restaurant with curbside takeout convenience, no waiting on hold, no standing in lines, no order mistakes as customers control the process. Customers can easily customize their orders.

As far as restaurant owners are concerned they can facilitate by having more orders, no hassle of having long lines and dealing with many customers at a time. Restaurants can have repeated customers and can get direct return on investment.

Conclusion

The focus of this paper is to get aid from location based services using cloud based mobile application. User can place food orders in a similar way as they do, when meet on lunch/ dinner at restaurants, by just using mobile application. On the other hand, food service providers need to maintain only one copy of their menus and use it everywhere on the web. The idea proposed in this paper is to use shared food basket by which only one user can place order on behalf of other users as well.

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