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A Mobile Commerce Architecture Based on Location Based Services and Social Media Monitoring

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Abstract— Mobile commerce is one of the fastest growing trends in technology. There are numerous architectures to provide complex mobile commerce solutions. This paper proposes a mobile commerce architecture that provides geographically important solutions. Location based services and Social Media monitoring are two popular emerging technologies. In the process of proposing mobile commerce architecture, this paper combines these two emerging technologies into a complex system. Firstly, this paper examines Location based services in detail. Secondly, the technology of social media monitoring is explained. Finally, the architecture is presented with its functionalities. Also considered in this proposal are the technological challenges for this architecture.

Index Terms— Location based Services, Mobile Commerce, Social Media API, Social Media Monitoring, Social Media Crawling, Quantitative social media monitoring, Qualitative social media monitoring.

1 Introduction

Mobile commerce is a process of conducting Electronic commerce through mobile devices. Since the technology surrounding mobile devices are increasing rapidly, the ability to do mobile commerce is also increasing. In this paper, mobile devices mean any smart phone, tablet, PDA or any hand held device that runs on an operating system and has internet capability for communication. Mobile device development has also grown rapidly in the recent past to accommodate many features such as Location positioning, Payment processing, and Mobile banking. Location based services are a process of providing various services to mobile users based on their geographical location. Location based services vary from locating the nearest ATM machine to locating a friend closer to the user. In a similar way, Social Media is another greatest invention in technology which is also growing rapidly in the recent past. This paper specifically discusses the architecture that combines Location Based Services and Social Media Monitoring together.

2 Mobile Commerce System

This paper discusses the designing of a mobile commerce system that combines Location based services and Social Media monitoring. This paper considers this system can be used to perform following use case functionalities.

- User of the mobile device can allow the system to notify them of geographically closer and highly discussed social discounts, events, services, or even jobs.
- Businesses can identify user interests that are discussed in social media and notify users about geographically closer business locations.
- Businesses can receive marketing data about geographically classified user trends and interests.

Some current systems offer partial solutions to the above use cases. However, this study found that none of them cover all the aspects of the use cases. More importantly, current social media monitoring tools rarely use Natural Language Processing tools to interpret information more precisely.

3 Location Based Services

In general, Location based services provide services as information about the geographical location. For an example, location based mobile applications provide local information such as traffic, ATM machines, restaurants, events, and retailers that are closer to the user. Over the time, user interfaces of mobile applications have improved to accommodate complex applications. High quality, wide screens and sharp graphics have enabled mobile applications to provide complex information to the user more accurately and clearly. Also technological improvements of positioning receivers in mobile devices have helped to calculate highly precise geographical positions.

The following section examines the methods of determining the location in order to understand the technological challenges in location based services.

Three types of positioning methods are primarily in use [1].

1. Satellite positioning
2. Network-based positioning
3. Local positioning

3.1 Satellite Positioning

Satellite based positioning system uses earth-orbiting satellites and earth bound receivers to position a location. The basis for this approach is that the distance from the receiver device and the orbiting satellites are known and the specific location can be calculated from such information. A minimum of three satellites are required to calculate a device's position. Satellite orbits are positioned around the earth in a way that every point of the earth will have signals from at least three satel-

lites. Signals from each satellite are considered as an imaginary sphere and the receiver device is at the intersection of three imaginary spheres. Each satellite's distance from the device is part of the information the device receives. Based on such information, receiver devices can calculate the position.

The satellite based positioning approach is highly accurate in the outdoors and very popular in mobile applications. However, this approach is not successful in identifying indoor positions. Also, satellite signals have poor reception in specific landscapes such as canyons.

Global Positioning System (GPS) is an infrastructure built by the U.S. Defense Department but available for commercial services. Other positioning systems in use or under implementation are Russian built GLONASS and European Union's Galileo [2].

3.2 Network based Positioning System

Mobile telecommunication networks are used to determine the location in this method. The idea behind this approach is to calculate the subscriber's device location based on the coverage signal strengths from network towers. Since the location of network towers are known, it is possible to calculate the device's location as it relates to the tower. Telecommunication networks use this approach to determine the closest tower to complete phone calls. The accuracy of the positioning is not as highly accurate as satellite positioning system. It also depends on the mobile signal coverage therefore many rural places do not have enough coverage to determine the location. The positive side of this approach is positioning can function even inside the buildings since mobile cell phone coverage can travel indoors. However, highly dense metropolitan areas may have signal jams that could result in lower accuracy in positioning.

3.3 Local Positioning System

Local positioning system is used in large indoor buildings where satellite or network positioning may not provide precise locations. Technologies which are capable of short distance signal transmitting such as Wireless Local Area Networks (WLAN), Bluetooth, Radio Frequency Identification (RFID), or Infrared (IRDA) technology, are used to build local positioning. Usually, the inside of a building is equipped with base stations that are emitting such short distance signals. The receiver device picks up the signal from the closest signal transmitting base and calculates the location as it relates to the closest base.

As it's discussed above, the challenge in providing precise location based services is the technological challenge in positioning both indoor and outdoor effectively. For an example, the location of an ATM machine within a town can be accurately positioned by using the address in satellite positioning approach. However, it is difficult to locate an ATM machine inside a huge shopping mall using the same satellite position. This type of challenge can be mitigated by adopting hybrid approaches. In hybrid approaches, satellite, network, and local methods can be combined to provide highly precise locations both indoors and outdoors in a limited way.

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4 Social media monitoring

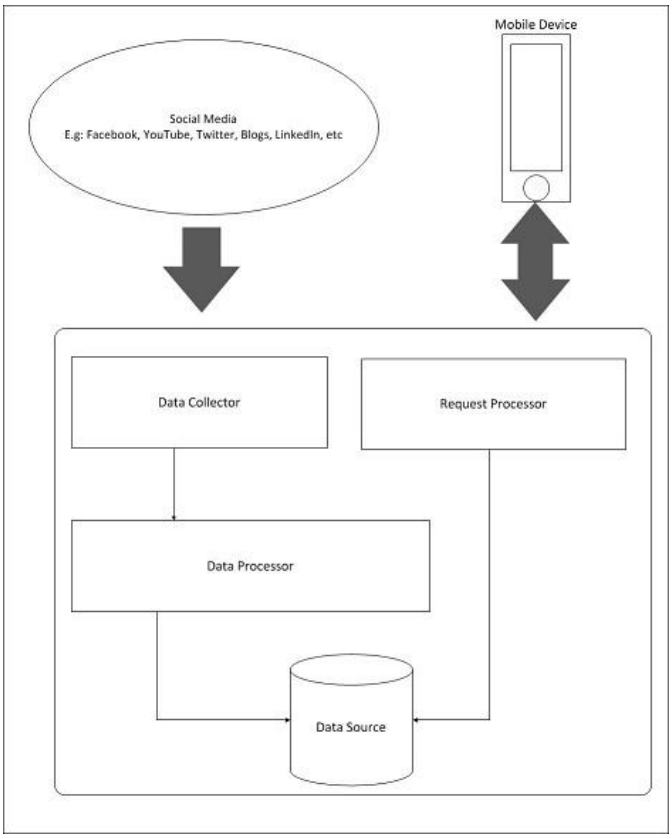
In the era of social media networks, monitoring the social trends in social media helps businesses to strategize their product development and marketing. It is very common that individuals share their perception and experience about a product or service in their social networks. Those perception and experience can be either positive or negative. Monitoring such comments is extremely important for businesses so they can competitively position their businesses in the industry. In larger corporations, whole departments are allocated to maintain social media programs.

There are two main categories of social media monitoring. They are Quantitative monitoring and Qualitative monitoring [3]. Quantitative monitoring tools provide methods to measure the number of social interactions. For example, quantitative tools measure the number of Facebook likes or fans, the number of twitter followers, or the frequency that a YouTube video is watched. On the other hand, Qualitative tools allow measuring the sentiment of the contents in social media. For an example, qualitative tools can be used to find the positive or negative comments in Twitter about a certain product.

Google Alerts is the oldest and simplest monitoring tool. It allows users to specify what they are interested in and finds related topics in the web. Google Alerts provide an opportunity for businesses to find what is being said about their product and services. Currently more sophisticated monitoring tools are available. Radian6 is one of the tools that allow businesses to socially engage with customers. Radian6's platform finds conversations all over the web whether they are on Twitter, Facebook, YouTube or any other blogs [4].

5 Mobile commerce architecture

This paper proposes the following architecture as a conceptual design. In this architecture, four sub systems are introduced in order to compartmentalize the functionalities. Each subsystem and their functionalities are described below.



5.1 Data Collector

Data Collector is a set of programs running on the server to provide raw data input from Social Media. Functionalities of these programs are very similar to web crawler programs. Web crawler is a type of program that is commonly used by search engines to search the entire web for key words.

Raw data gathered by data collector is a combination of social media status updates, comments, likes, events, group pages, and blog posts in the web. Almost all the major social networks offer public APIs to search and gather data from their sites. Twitter offers streaming API which provides real-time tweets as they occur [5]. Similarly, Facebook provides Graph API which offers searching all public posts, pages, events and groups [6]. YouTube also provides search API to query uploaded videos which matches a specified search term [7]. Data Collector system searches each social network side individually for data. Many web blogs do not offer any APIs to search for. For such blogs, Data Collector sub system sends standard web crawler types of programs to search the web for blog updates. The Data Collector also collects geographical locations of the posts along with raw data. Many social media APIs provide the feature to retrieve the location.

5.2 Data Processor

The main functionality of this system is to process raw data into meaningful information that can be indexed and stored in Data Source. Parsing linguistic text data into meaningful information is a challenging process. Interpreting natural language like English to machine readable language has many steps and methods. Many steps in that process are still in the research level. Sentimental Analysis is one of the methods to analyze the text which allows users to differentiate positive and negative sentiments in the text. This approach is widely used in online reviews to evaluate user reviews. However, using this approach would not provide any additional information such as the context or meaning of the text. Word Sense Disambiguation is a technique to remove the ambiguity of the word in a text [8]. Since natural languages have multiple meanings for a single word, this technique is essential to understand the correct context of the text. In Word Sense Disambiguation, a large dictionary with possible words and contexts is used to match with input words to determine the meaning. Another technique is Information Extraction [9]. In Information Extraction, given sentences will be extracted into structured meaningful texts. The relationship between words also identified in this process. This process is important in determining name, event and locations in a text. The challenge in interpreting natural language is that there is no method available yet that can translate with 100% accuracy.

Upon completion of data processing, parsed data along with its geographical location will be stored into Data Source. As it stated above, in many cases, social network APIs provide location information as well. In other cases, location also must be extracted from the text if location related words are mentioned.

5.3 Data Source

Data Source is a simple database system that stores large chunks of data with geographical locations. Parsed data also indexed by keywords and geographical locations so it can be searched and retrieved efficiently. This study finds that traditional SQL based databases are relatively slower to store and retrieve large chunks of text data. Therefore, this paper recommends using a NoSQL type database which allows storing large chunks of data across many machines. Also, importantly, a NoSQL type database runs faster compared to traditional RDMS.

5.4 Mobile Application

In this architecture, mobile application is a program that runs on the mobile device. This specific application plays a role of interface between the user and the system. Users are allowed to set their preferences such as sharing their location and mobile commerce options. Mobile commerce options are a users' preference in the type of services they like to receive. The mobile application sends this information to the system server. The mobile application can be either mobile browser based application or an application which is native to the operating system running on that mobile device.

5.5 Request Processor

The request processor receives the message from the mobile application and parses the request in order to get the exact information. Parsing is similar to what the data processor does but historical and statistical data also combined in request parsing in order to interpret more precise information. Historical and statistical data includes the requests previously made from the same mobile device. Based on the request, relevant

information can be retrieved from the Data Source.

6 Conclusion

This paper introduced the conceptual architecture of a Mobile Commerce design. This approach combines location based services and social media monitoring together to provide innovative solutions. Technological challenges in certain implementations are also mentioned. Interpreting natural language to machine language is the main technological challenge which requires many research solutions. Each subsystem in the architecture can be subjected to individual research subject. Using this architecture as a base concept, many possible business and marketing applications can be derived.

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