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MSEARCH: A Mobile Search Service

Stephen Agyepong, Michael Franklin Bosu and James Ben Hayfron-Acquah
Department of Computer Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Abstract: The primary goal for this study is to employ SMS technologies to serve the search needs of our clients. In this paper, we propose a mobile search service that was built using the Wireless Application Protocol (WAP) on top of SMS technology that allows complex queries and interaction between the user and the system. For example, a text message may be sent by a user to a short code to search for a restaurant like this: restaurant <city>. Our system offers our clients the ability to update their information.

Key words: External short message entity, search service, short message service, SMS search, wireless application protocol

INTRODUCTION

Search has been a human activity since creation. The advent of the internet has contributed immensely to an easy way of looking for information electronically. SMS has a huge patronage among users of mobile phones since it is cheaper than voice calls. In Ghana mobile phones are in wide patronage compared to the internet which has less than ten percent penetration among the populace, thus a mobile search service relying on the cell phone seems a highly plausible proposition.

Mobile search is receiving a lot of attention from global giants such as Google and Microsoft and the general public for good reasons. It is emerging as a major source of revenue for search providers and network operators because it allows people to find what they are looking for instantly and conveniently. Retailers love impulse buyers. Mobile search provides the tools to encourage and accommodate impulse buys so retailers are happy to put their advertising money where the consumer is at. It has become an always on tool to make the life of the user much better. In a country like Ghana where there is limited internet access and so people spend a lot of time and money going from one place to another looking for what they need, mobile search has the potential to reduce search time and cost. For example, if a mobile phone user hears of a new product on the radio, they can use mobile search to find the product and purchase it instantly instead of waiting to get home in front of a personal computer before buying it or driving to the shopping mall to buy it.

A project of this magnitude would have cost a lot of money using proprietary solutions but thanks to open source technologies and tools, the software was developed at a fraction of the cost. Although the primary aim of this study is to use SMS to provide a search service that allows our users to easily locate information about important services and facilities, we will also like to show how a prior work by the authors on how to use key-value pairs to formulate complex queries and user interaction (Agyepong *et al*., 2011) has been used to develop a really complex application like the mobile search service. The search service also demonstrates how to overcome the 140 bytes of data limitation of the Short Message text message by using a paging technique that allows an unlimited amount of data to be sent to the user. Our system can be accessed from the sabonay.com website (Sabonay, 2010).

LITERATURE REVIEW

Several articles have been written about mobile search. In this section we present some of these related works with special emphasis on SMS. In “Designing a New Mobile Search Service:a User-Centered Approach”, (Davies, 2008) explores a User-centered Design (UCD) approach to the design of a new, mobile internet search engine aimed at consumers in a commercial context. The Wikipedia defines mobile search as “an evolving branch of information retrieval services that is centered around the convergence of mobile platforms and mobile handsets or other mobile devices. The services allow users to find mobile content interactively on mobile websites, and mobile content shows a media shift toward mobile multimedia. Simply put, mobile search is not just a spatial shift of PC web search to mobile equipment, but is witnessing more of treelike branching into specialized segments of mobile broadband and mobile content, both of which show a fast-paced evolution.”

Corresponding Author: Michael Franklin Bosu, Department of Computer Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Wikipedia continue to say "Mobile search is a battle to define perhaps the most important new interface with the consumer, whoever cracks the consumer and commercial code for delivering and monetizing relevant answers for people on the go will secure a license to print money, at least for a time". Conventional wisdom has it that there has been three "screens" or interfaces. These interfaces are the television, the personal computer and now the mobile phone. There is a battle going on for dominance of the mobile phone and mobile search among the global titans such as Google, Microsoft, and Apple. The Mobile Marketing Association (MMA, 2006) in their "Introduction to Mobile Search" provides an overview of mobile search in terms of how it differs from traditional internet search and how mobile search meets the needs of consumers, operators and marketers. The document also discusses mobile search strategies, business models, and challenges.

Karlson *et al.* (2006) created a search interface that made it easier to navigate and search large data sets during browsing and search tasks on the mobile phone. Their solution "FaThumb" was a search solution for devices with limited input and display capabilities - specifically keypad based mobile devices. One of the methods they adopted was a navigation and selection of hierarchical metadata (facet navigation), with incremental text entry to further narrow the results whilst the other method uses a text based entry. They conducted a formative evaluation to understand the relative advantages of keyword entry versus facet navigation for both browse and search tasks on the phone. They concluded that keyword entry to be more powerful when the name of the search target is known, while facet navigation is otherwise more effective and strongly preferred.

The Google SMS (Schusteritsch *et al*., 2005) project was developed to enable users access specialized information when they are mobile since most of the users were already using Google search service on the personal computer. The service was primarily aimed at supporting searches for specialized information such as business listings, residential listings, product prices, dictionary definitions, area codes, and zip codes.

Users simply send their query as a text message and receive their results in the reply. It enabled users to search for information without having to upgrade their phone to new once or subscribe to specialized mobile data services. The user sends a query in a text message to the Google SMS short code (the service was only available in the US, at short code 46645). Google receives the user's message, parses the query, attempts to retrieve relevant information, and sends results back in one or several SMS messages.

The main focus of the Google SMS team was to overcome two major constraints: the technical limitations of the SMS standard, and users' current conceptual models of both SMS and Google search (web). They were not able to overcome these constraints; however we have adopted a paging technique (Agyepong *et al*., 2011) to overcome the first limitation.

In SMSFind, an automated SMS-based search response system that is tailored to work across arbitrary topics (Chen *et al.*, 2010), the authors used a combination of simple Information Retrieval algorithms in conjunction with existing search engines that was able to provide reasonably accurate search responses for SMS queries. Using queries across arbitrary topics from a real-world SMS question/answering service with human-in-the-loop responses, SMSFind was able to answer 57.3% of the queries in their test environment. SMSFind enabled users to obtain extremely concise (one SMS message of 140 bytes) and appropriate search responses for queries across arbitrary topics in one round of interaction.

Collins *et al*. (2007) describes an SMS based text messaging system that delivers real time bus information to users' mobile phones. Users only send a stop code at their current bus stop to a phone number and the arrival time of the next bus is sent to the user's mobile phone. The ideas that run through all these discussions are: market drivers for mobile search, the difference between mobile search and internet search, opportunities for industry players (mobile operators, marketers, and search providers), challenges mobile search faces and the way forward for the mobiles search industry.

According to internet usage statistics for Africa published by internetworldstats.com Ghana has seen over 2000 percentage point increase in the number of internet users since the year 2000. Sadly the number of internet users as a percentage of the population is a mere 2.8 percent. This means that any system developed for this environment will have to work even without internet access.

METHODOLOGY

We conducted a survey of potential users both in the cities of Accra and Kumasi in Ghana between the year 2009 and 2010 to gather system requirements and to find out what people are looking for, whether they will be willing to pay for a mobile search service if it was available, how much they were willing to pay for, how often they look for things, where do they go to or look for things?, etc. It came out that for high ticket items people just go to downtown or the central market. If they do not know where to get an item they will ask a friend or family member. If they happen to be in town already they would ask merchants or even strangers.

When we told people we were working on a system that would allow people to search for things such as hotels in a given city or town and that they could specify how much money they were willing to spend, so that hotels

Table 1: Comparing cost of open sources versus proprietary solutions

Tools	Proprietary	Cost	Opensource	Cost
IDE	Visual studio	$2367.99	NetBeans	$0
Application server	Web logic	$30,587	Glassfish	$0
Database	Oracle	$6,402.00	Mysql	$0
Reporting tools	Crystal report	$746.99	JasperReports	$0
Version control	Visual source safe	$510.30	subversion	$0

Shopping at google.com

within that price range will be listed, and the class of hotel they were looking for, they were excited. The comment we got most of the time was "what a brilliant idea, we really need something like this in Ghana," "how soon are you going to make this service available?" But it was obvious, they consider the between 30 and 40 Ghana Pesewas fees that needed to be charged to cover the operating expenses and compensate the network operators for the use of their networks to be expensive.

We gathered user requirements during our conversations with potential users. They told us they want a user-friendly system where they don't have to type a lot, given that most people have cell phones with numeric keypads that makes entering characters cumbersome; they want a system that would give them basic information without clutter; and lastly they want a system that is available all the time and available anywhere with or without internet access since most people were not going to have internet access. They told us, for example, when looking for a hotel they want the names of all hotels in a given city or town. If the city or town has suburbs they want to know which suburb the hotel is situated; their phone numbers, address, physical location, and price for the various room types.

Given our understanding of the user requirements we started work on a prototype or what we called a proof of concept. We know a lot of cell phones are Java enabled so we used Java Platform Micro Edition (JavaME) for development. The prototype worked great. In fact, it was more user friendly than sending a text message. We abandoned the JavaME approach in favor of sending a text message because we wanted anybody with a cell phone to use our service.

Cost of project: We were able to minimize the cost of the project by using open source tools and solutions as shown in Table 1. Table 1 depicts that the cost of the tools used in developing MSearch was zero. We further reduce the cost by employing computer science students of the Department of Computer Science at the Kwame Nkrumah University of Technology who were eager to learn. It was a win-win for all the three parties involved, the researchers and Sabonay was able to get the work done while the students got some invaluable development experience.

System architecture: The MSearch System Architecture is made up of four major components as shown in Fig. 1 the Short Message Service Center (SMSC) or the network operator, the External Short Message Entity (ESME) or search provider, cell phone users and internet users.

The cell phone user sends a text message that is received by the SMSC who then forwards it to the appropriate ESME. The ESME processes the request and sends back a response, if applicable.

Query and paging of results: We describe the paging technique used in our earlier work (Agyepong *et al*., 2011) in this section. A major limitation of SMS text messages is the 140 byte limit per message. This means that we will have to break up messages longer than 140 bytes and ask the user to let us know when they need the next message. The problem that arises when we break up messages is how do we know when the user is done asking for more messages? Say we break up the messages meant for the user into 10 parts; we send the first message, the user asks for the next message and did not send us any *NEXT* message for another 5 min. How do we know the user is having problems sending us the next message, the user is done because the previous 2 messages gave them the answer they were looking for?

Each message to be sent to the user is stored on the ESME's system and therefore is cost to the ESME. The more of such messages that are kept the longer it takes to response to requests to send additional messages since we have a longer list to search through. We use a timer service that runs periodically deleting messages that have been waiting for a specified time period.

Message format:

The text message should be of the form:
<keyword> argument(s) or
<keyword> <sub-keyword> argument(s)

The *keyword* is the thing or item you are looking for, for example, hotel, hostel, embassy, police station, television stations, fm stations, etc. The *sub-keyword* is a literal which qualifies the keyword for example, info, add, update, etc. The *argument(s)* is the additional parameter(s) required by the keyword.

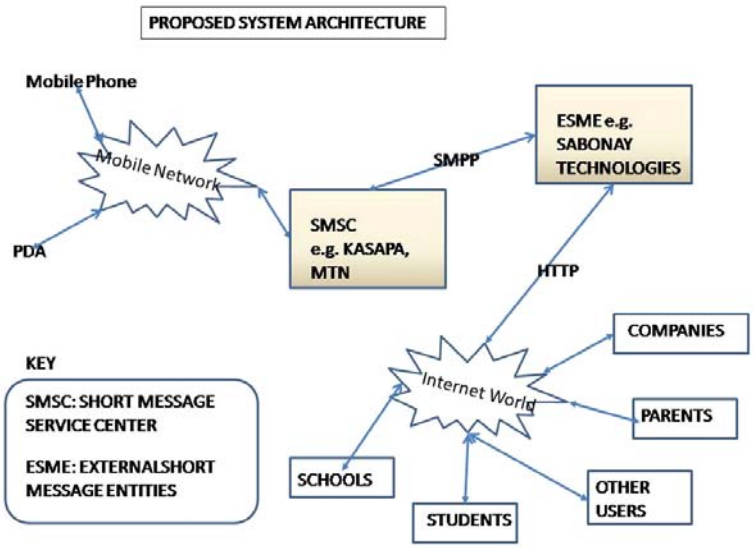

Fig. 1: MSearch system architecture

The format allows for abbreviated words to ease typing the text message. For example, city may be abbreviated as ci or c, suburb as sub or s, television as tv, and embassy as emb, etc.

If a word has white space or special characters such as & and @, then it should be put in double or single quotes. For example, the city Sekondi Takoradi should be entered as a quoted string like “Sekondi Takoradi.”

When the response does not fit into one text message as above it is broken down into several pages. The user is informed about how many pages there are and asked to send a text message with just NEXT to retrieve the next page.

Text messages are case insensitive. This means that KUMASI is the same as Kumasi or kUMasi, etc. This small feature we hope will make it a little easy on the cell phone user to send text messages.

Here are examples of messages that may be sent by the user and response from the system:

msg> hotel c kumasi s dichemso p 30,50
resp> Diamond hotel, Box KS 7085, Adum-Kumasi, 03220-29905, s GHc37.40; d GHc41.00;

The user wants all hotels in Dichemso, a suburb of Kumasi, with price of rooms between 30 and 50 Ghana Cedis. The results show a single room at GHc37.40, and double room at GHc41.00 at the Diamond hotel.

msg> embassy accra
resp> embassy of algeria diplomatic 0302776719; 1 of 56 <Send NEXT>

A request for a list of all embassies in Accra.

msg> tv info "tv 3 network"
resp> tv 3 network ltd. comid=2753 0302763470 Accra Kanda adjacent french embassy

A request for information about TV3 Network. The response says its company ID is 2753 (assigned by Sabonay Technologies), phone number 0302763470 and situated adjacent French embassy.

In formulation of search request, our system, MSearch request the location of interest from the user for two reasons: (1) we do not have the location information of the user, and (2) even if we have the location information it is possible that the user may be in one city but wants information about another city. For example, the user is in Accra but is planning a trip to Kumasi so needs information of hotels in Kumasi.

Client data update: Price and other information may change, sometimes more than once in a year. In order to make sure that our system is kept up to date we allow our clients, for example, hotel owners, four ways to update their information: (1) send us email, (2) call us, (3) go to our website and update their data, and (4) send us text message with the new values.

For a client to update their information using their cell phone, they will send us an SMS message like this:

msg> hotel log t167page "Sabonay1&"
login the company with user name t167page with password Sabonay1&
msg> hotel up 167 s 85.50
update the single room rate of company with ID = 167 to 85.50 Ghana Cedis

msg> hotel logo t167page
logout the company with user name t167page

The user name and password can be part of the update message, for example:

msg> hotel up t167page "Sabonay1&" 167 s 85.50
login user= t167page password="Sabonay1&" and update the single room rate of company with ID = 167 to 85.50 Ghana Cedis

CONCLUSION AND RECOMMENDATION

We have been able to use open source technologies to provide a cost effective solution to the search needs of our clients. Because most people have access to mobile phones compared to the internet, our solution relies on SMS to provide search service that allows our users to easily locate information about merchandise, hotels and hostels, hospitals, schools and other important services and facilities that are of interest to people.

For our solution to have the desire national effect and wide spread use, the populace will need to be educated about the existence and benefits of such a service. Presently, people are wasting a lot of money and time going from place to place looking for things they might not find. If they are lucky to find the items that they were looking for, it may turn out not to be within their estimated means, which may require another trip back to the shop.

Making the equal (=) and comma (,) keys easily accessible, by cell phone manufacturers, will greatly facilitate the formulation of search queries using SMS text messages thereby making our system easier to use.

Standardizing common abbreviations for commonly used names such as cities, regions, food, etc for example, ksi for Kumasi, eat for restaurants to our vocabulary will cut down on the amount of text needed to be typed.

SMS should encode capabilities of sending phone so a message can be formatted for the phone. For example, if the phone is WAP enabled the text message will be formatted as a WAP message. Currently users are not used
to typing key-value pairs and therefore may require some amount of education to get used to the idea but we hope with time this will change.

Future work: Future research will focus on semantic search to automate search thereby enhancing the user experience. As more phones come out equipped with GPS functionalities we expect to integrate our search to take advantage of the enabled presence to give the user more capabilities for their money.

At present, our system returns a “NOT FOUND” message if you send a message that is not recognized. In the future, we plan to integrate with search engines such as Bing, Google, or Yahoo so that if the message is not recognized it will be passed on to one of these search engines and the results passed on to the user.

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