An SMS and USSD Model for Location-based Mobile Advertising

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Abstract—The use of mobile phones to deliver context specific information in the form of advertisements tailored to a user's profile, location among other related characteristics has been on the increase in the last few years. Location, in particular, is a key attraction to businesses in the delivery of advertisements. However, the widespread adoption of these applications continues to be hindered by among other factors the use of location determination and information delivery technologies such as GPS, Bluetooth, JAVA apps and WAP that are not universally available and accessible. Our proposed model for the development of a location based mobile advertising system is based on universally accessible and available technologies, namely SMS and USSD. The system uses symbolic locations and USSD drill down menus for user registration and information access. SMS is used for the delivery of the desired information to the user. This comprehensive solution architecture will be instrumental in the development of a new class of LBMA applications solely based on SMS and USSD.

Keywords; SMS, USSD, Location-based mobile advertising (LBMA)

I. INTRODUCTION

Location-based mobile advertising (LBMA) is the use of mobile devices to provide customers with time and location sensitive, personalized information for the promotion of goods, services and ideas in order to generate value for all stakeholders [1]. LBMA delivers context specific information by first establishing the location of users by means of technologies and services such as Bluetooth, Radio-Frequency Identification (RFID), Near Field Communication (NFC), wireless networks and location-based systems using Global Positioning Services (GPS) technologies [2]; [3]. This location information is then used to identify relevant information which is subsequently sent to the user using text messages, Wireless Application Protocol (WAP) or delivered on mobile applications. However these technologies used for location determination (RFID, Bluetooth, NFC and GPS) and for the delivery of information (WAP and JAVA applications) are not universally accessible or available on all types of mobile phones.

This paper presents a Location-based Mobile advertising model based on SMS and USSD, technologies that are available on the most basic of phones and in all network conditions. The system uses a pull approach to request for contacts, i.e. name and mobile phone numbers, from a database of service and product providers. These contacts and services or products offered are provided by businesses through a registration process. The proposed model uses symbolic locations and makes it possible to offer location-based mobile advertising services using SMS and USSD services.

II. LITERATURE REVIEW

In this section we highlight a number of technologies currently in use for the development and delivery of location-based mobile advertising services as well as systems developed using them.

The Global Positioning System (GPS) is a space based satellite navigation system that works in tandem with mobile devices equipped with GPS receivers to output either a 2 or 3 dimensional positional data [4]. It has been used for obtaining positional information by Dawood, Jackson and Yew [5] in a vendor tracking system and in the location-based mobile advertising system proposed by Sammut et. al [6], that requires GPS capabilities to determine user location.

Bluetooth is a short-range wireless low-cost and low-energy technology that enables devices to form networks and exchange information based on a master-slave connection model [7, 8]. It has been used to obtain position information in a number of location based mobile marketing applications such as the B-MAD (Bluetooth

Mobile Advertising) [9], a Bluetooth mobile context aware system by Alexandre et. al [3], and a Bluetooth location-based advertising system by Rashid, Coulton and Edwards [10].

Wifi defines any wireless LAN product based on the IEE 802.11 Standards that allows devices to get wireless access to network resources [11]. Examples of LBMA that use Wifi include MobiAD by Haddadi, Hui and Brown [12], and iAd which is a mobile advertising platform for the iPhone, iPad and iPod that leverages uses WiFi and 3G networks to deliver ads to users [13].

Ad-hoc networks consist of nodes that communicate with each other in the absence of a fixed infrastructure and without central control [14]. An example of a LBMA utilizing this technology is eNcentive, an agent based framework proposed by Ratsimor et al. [15], for peer-to-peer electronic marketing.

JAVA is a general-purpose, concurrent, class-based, object-oriented computer programming language that allows application developers to develop applications that are device independent [16]. It has been used in the development of a location-based mobile advertising system proposed by Sammut et. al [6].

WAP is a standard that enables easy and fast delivery of information and services to mobile device terminals that have limited displays and data transfer capabilities [17]. It is the protocol of choice for mobile web browsers. A number of LBMA are web based including the SMMART (System for Mobile Marketing: Adaptive, PeRsonalized and Targeted) Kurkovsky and Harihar, [2], that uses the web both for access and delivery of location specific information to a client; AdMob which is a mobile advertisement platform developed by Google that helps mobile app developers to promote their apps and to serve context specific advertisements on them [18]; and the Placecast advertising platform utilizes general location information that is derived from the user's current public IP address [19].

Most of these technologies such as GPS, web browsers and JAVA are only accessible on relatively costly feature and smart phones. In addition, some of these networks such as the mobile ad-hoc networks, Wifi and Bluetooth have limited reach. It then follows that applications developed to ride on these technologies also have a limited geographical and socio-demographic reach.

Short Messaging Services (SMS) is a basic service offered on the Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS) and Code Division Multiple Access (CDMA) networks that allows mobile devices to exchange messages with a short amount of text limited to 160 characters. It is a store and forward way of transmitting messages between mobile phones that allows messages to be stored briefly in case the recipient is not available [20]; [21].

All GSM handsets can send and receive SMS's which can be sent and received from any network in the same or different country. Its main limitation is the limited message size to 160 characters as well as its inability to transmit non-text data. Compared to Unstructured Supplementary Service Data (USSD) all SMS messages must be explicitly typed before being sent. These challenges limit its wider commercial application [20]. SMS was first used commercially in 1992 by Vodafone in the United Kingdom (UK) to inform its clients about voice mail messages [22]. The simplicity and low cost of SMS has made it the most popular mobile messaging method with over 7 trillion messages being sent in 2010 [23].

Typical SMS applications can be classified as (1) Consumer applications that include person to person messaging, interactive information services (obtaining weather forecasts), entertainment services (downloading ringtones) and location based services (restaurant suggestions based on handset locations), (2) Corporate applications that include notification and alert services (product expiry and renewal dates, emergencies), contact, correspondence and appointment management and vehicle tracking, and (3) Mobile service provider applications that include SIM card updates (customer profiles and address book entries) and WAP push with URLs for advertisements to be viewed on the user's mobile browsers [24]. An example of the use of SMS in LBMA is the Claro SMS-Based Location-Based service [25] and the vendor tracking system by Dawood, Jackson and Yew [5], used for sending vendor information to clients.

USSD (Unstructured Supplementary Service Data) is a GSM communication technology that is used to send messages between a mobile phone and a network based application server [26]. It is a device and Subscriber Identity Module (SIM) independent and highly cost effective messaging service that is seven times faster than SMS. USSD is able to support interactive menu based applications that make simultaneous voice and data communications possible [27].

USSD has been used for the development of mobile chatting, m-commerce, pre-paid balance inquiries, callback services, software upgrades and mobile banking services [26]; [27]. These services are available as 'pull' based services such as news updates, weather, movie information, sports updates, currency updates, stock market reports, telephone directory and yellow pages. Voting / polling and emergency information are examples of 'push' based services. It is also used for advertising where businesses get listed on menu based USSD systems in order to promote their services [26].

The use of USSD presents a number of advantages. It is faster with average response times of 2 seconds, is supported by all GSM phones, is phone and SIM card independent, users do not need to type messages or remember short codes to access services, its menu based interaction makes it possible to offer self care applications for Value Added Services (VAS), helps network operators to increase Average Revenue Per User (ARPU) and works well even when users are roaming. On the other hand, USSD keeps resources assigned for the duration of the transactions leading to increased traffic on the communication channels between the mobile network's Message Control Centers (MSC) and Home Location Register (HLR). In addition messages sent are not stored on the handset for future reference [26]; [27].

III. THE LOCATION-BASED SMS AND USSD PULL MOBILE ADVERTISING SYSTEM ARCHITECHTURE

The SMS and USSD LBMA is a platform for linking businesses and potential clients in instances where the only medium of communication is voice, SMS and USSD. This kind of scenario can be occasioned by the lack of access to advanced positioning technologies such as GPS and Bluetooth, the lack of phones with capabilities to use these advanced positioning technologies, and the lack of resources to develop and use LBMA based on these technologies. The proposed solution thus provides an option for businesses who are faced by these kind of circumstances as well as potential clients who may not be able to access LBMA that require either GPS, Bluetooth or internet access.

The proposed system, presented in Figure 1, describes the overall architecture of the proposed solution. It comprises of four main components;

1. **Users:** There are two main types of users;
    a. **Clients:** These are individuals seeking for services and products from businesses. They are interested in obtaining the mobile contacts of possible providers in order to contact them. The information they require is preferably location specific. They are also the target of advertisers who profile them based on their age, gender, location and type of inquiry that they are making.
    b. **Providers/Businesses:** These are enterprises who wish to make their location, products and services known to potential clients. They are also able to specify the kind of clients they wish to serve in terms of age and gender as well as the times they wish to be contacted. They also get the contacts of all potential clients to whom their information has been sent.
2. **Mobile Network Providers:** Their infrastructure is used to transmit SMS and USSD messages.
3. **Premium Rate Service Providers (PRSP):** They provide the SMS and USSD message aggregation for onward forwarding to the application server. They also provide bulk SMS and Short codes for use on the system.
4. **Location-based SMS and USSD Pull Mobile Advertising System**

This is the core of the architecture and it comprises of the following major components;

a. **User authentication:** This sub-module checks to see if all users are registered.
b. **User registration:** This sub-module handles all user registration processes. For potential clients, name, age, national ID number and gender, are required. Businesses are additionally required to provide their location and products/services offered.
a. **Location Module (LM):** This module presents a list of symbolic locations to the client on the USSD interface and queries the symbolic location names from the database.
b. **Core Application Logic (CAL):** This module receives user requests, searches the database and returns results in the form of an SMS to the client. It also sends out an SMS with the potential client's contact to businesses whose information has been sent out.
c. **Databases:** The system maintains four main databases; users, providers, services / products and symbolic locations.

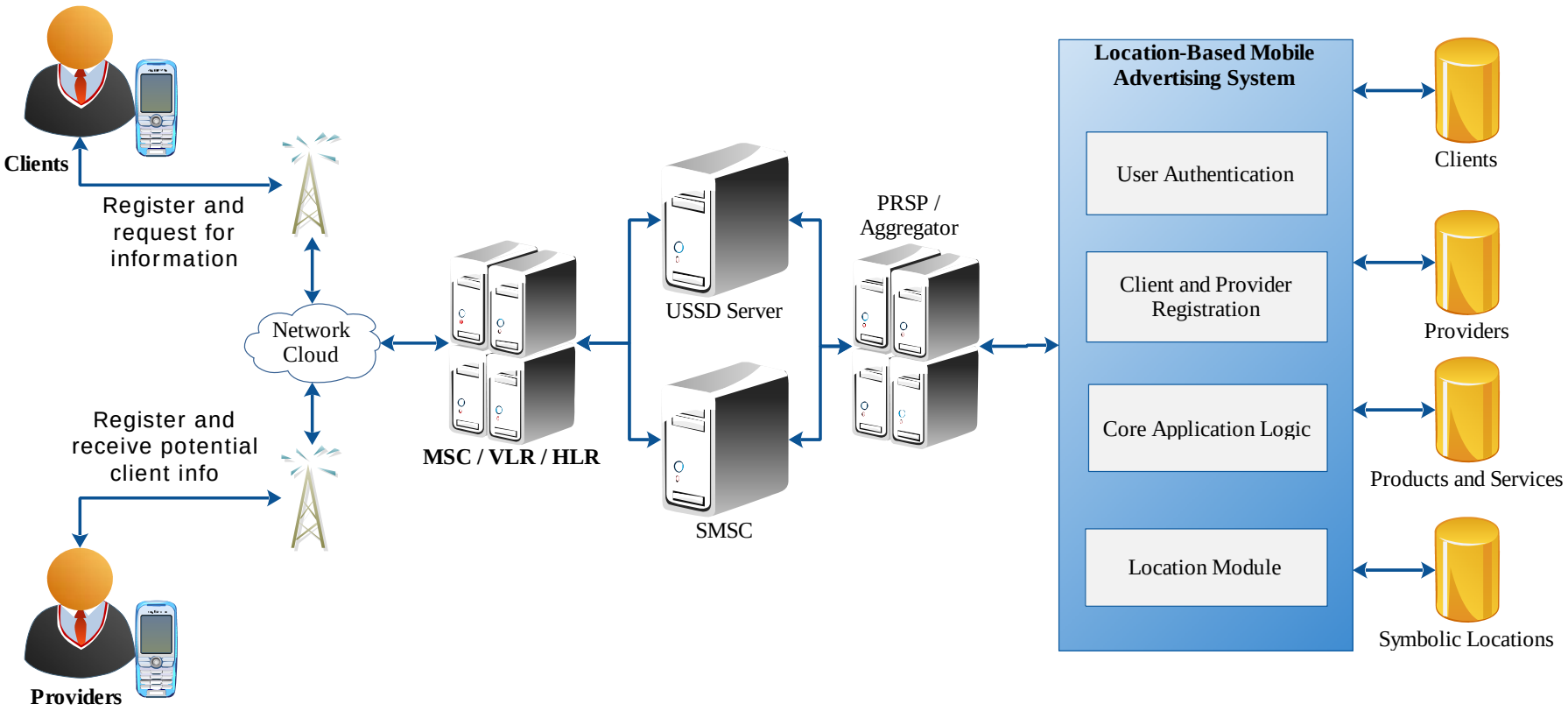


Figure 1: Overall USSD and SMS location-based pull mobile advertising application architecture

IV. DESIGN OF THE LOCATION-BASED SMS AND USSD PULL MOBILE ADVERTISING SYSTEM ARCHITECTURE

A. System Overview

There are three main functions of the system; user registration, provider registration and information search. The user/provider registration is done using a web interface and the information search functions are accessed using a USSD menu with responses to being sent on SMS. An overview of the system use is depicted in Figure 2**.**

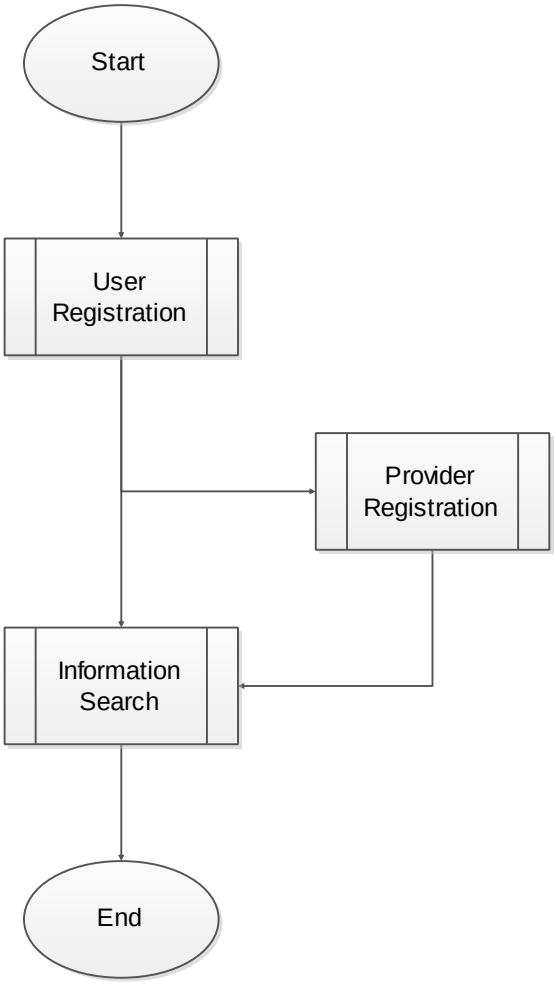


Figure 2: Flow chart of the LBMA system use

B. User Registration Process

The registration process is the entry point into the system and caters for the two types of system users, namely; clients and businesses. Clients register by providing their name, age, national ID number, mobile phone and gender. Businesses, in addition indicate the type of product or service that they offer.

The user registration process is outlined in Figure 3 and the provider process in Figure 4.

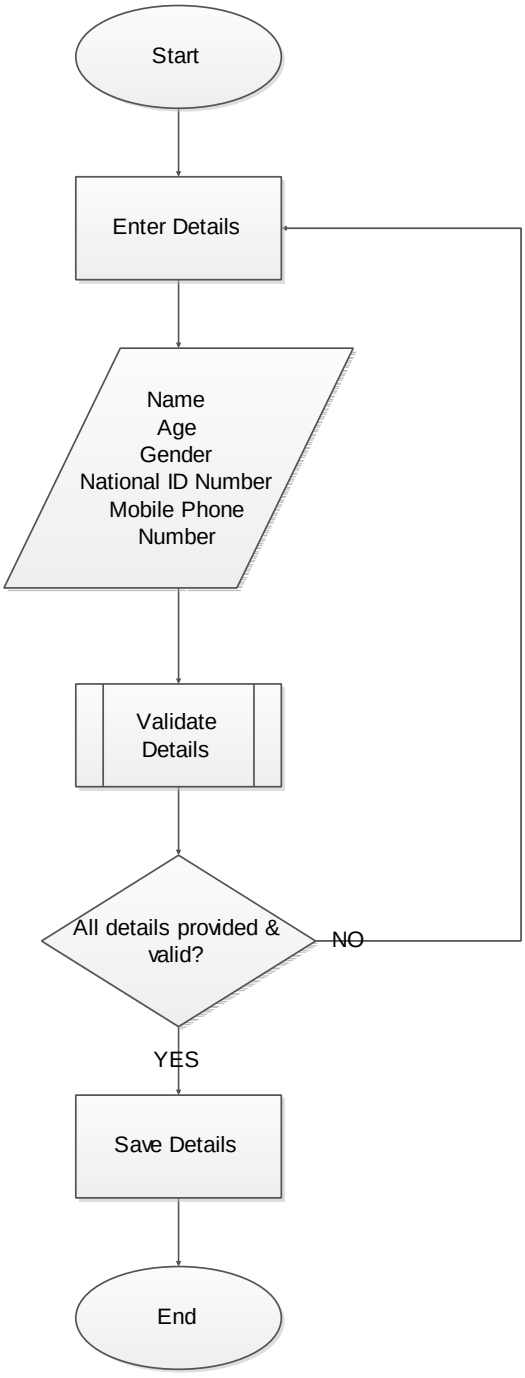


Figure 3: User Registration Process

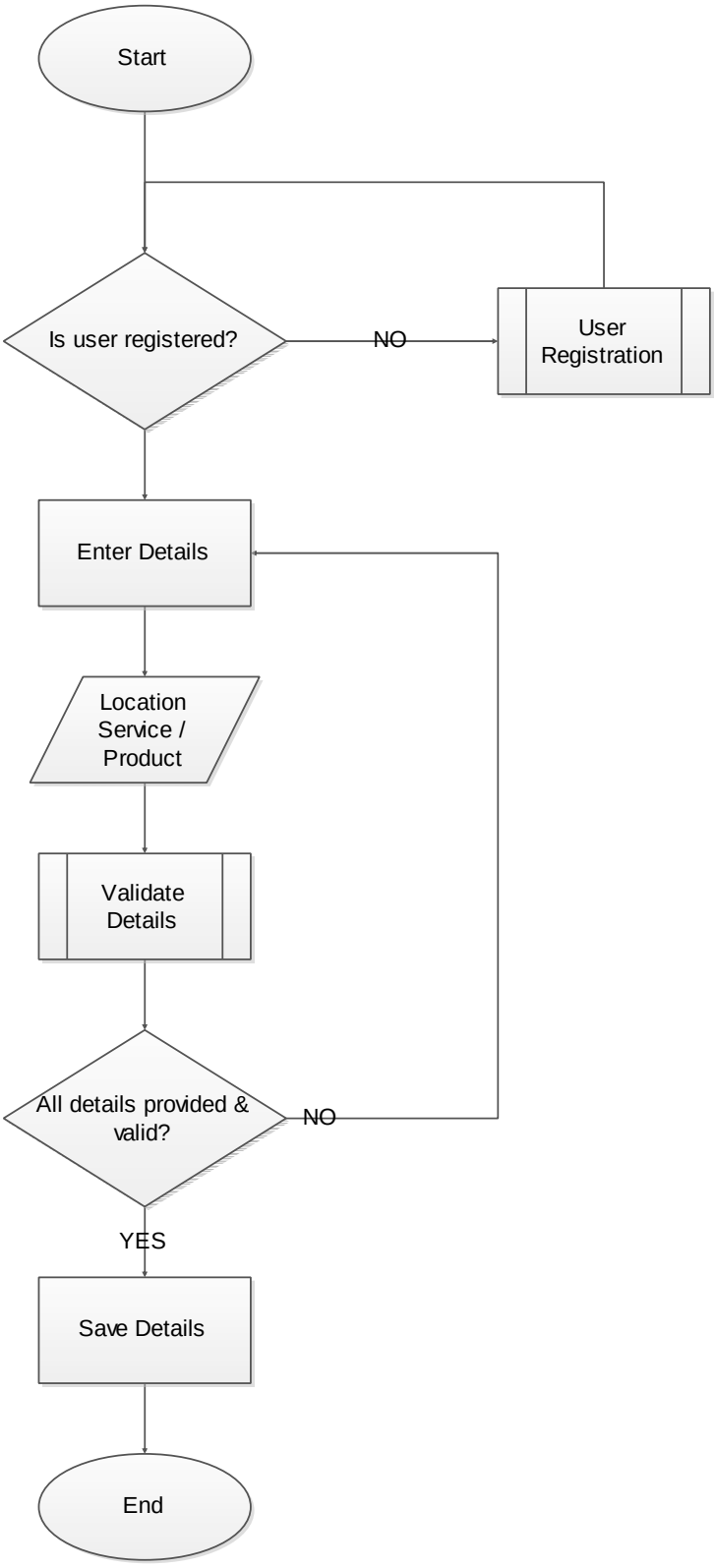


Figure 4: Provider Registration Process

C. Information Search Process

The information search process, outlined in Figure 5, is performed using a USSD drill down menu. The USSD menu guides the user in the selection of a location and a product or service before triggering an SMS to the user with the result. The location information used for the system is not real-time, rather, it consists of a list of records in a database that is matched against a user's inquiry. The SMS sent to the user contains at least 5 contacts of identified and available providers in the form; *name, mobile number*.

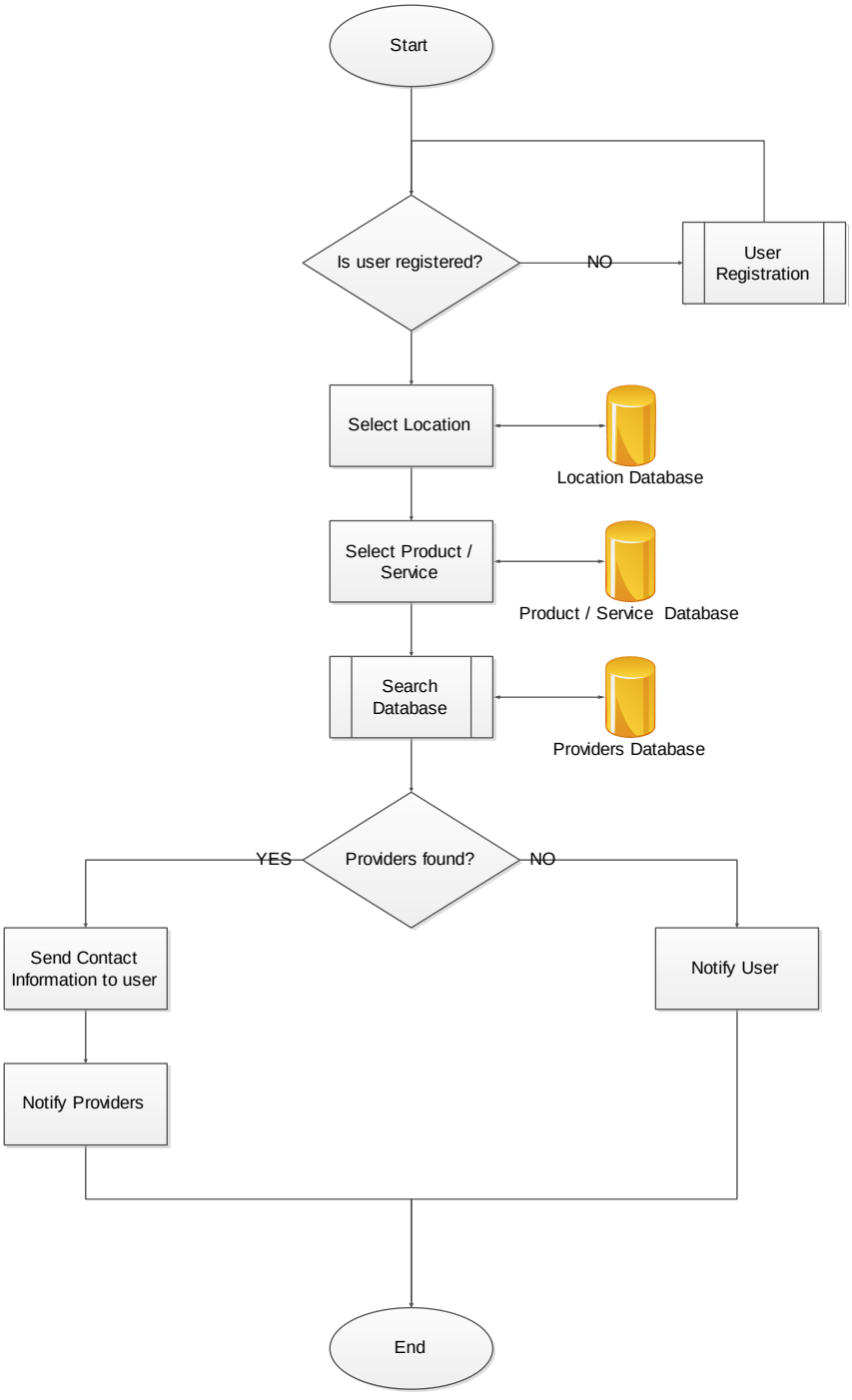


Figure 5: Information Search Process

D. Entity Relationship Diagram

The entity Relationship diagram for the system is presented in Figure 6. It comprises of 9 tables that contain four main types of information;

i. User and provider information: lbs_user, lbs_gender and lbs_providers.
ii. Product and service information: lbs_category and lbs_product.
iii. Location information: lbs_county and lbs_location.
iv. Transactional information: lbs_register and lbs_search.

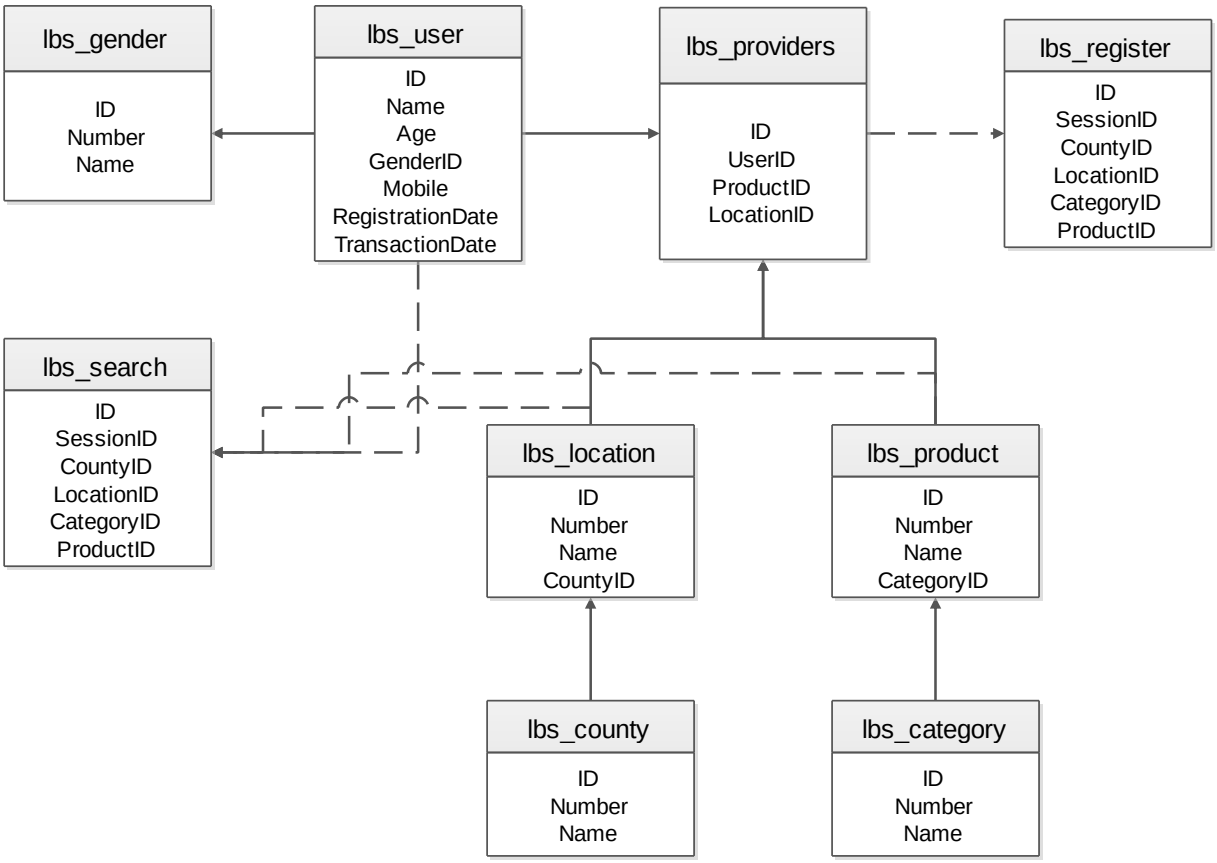


Figure 6: Database Design for the SMS and USSD Location-Based Mobile Advertising System

V. PROOF OF CONCEPT

A. Development tools and environment

A program was developed to implement the USSD and SMS model for location based mobile advertising. The program was developed using the PHP programming language and the MySQL database for data storage and retrieval. The development environment was the Windows 7 operating system using the Adobe Dreamweaver CS3 IDE. The Apache web server was used to host and test the system locally.

B. Testing environment

The system was then hosted on a USSD test-bed for testing. A bulk SMS account was also obtained for use in sending the messages to the users during the testing process.

C. User registration process

Users fill a registration form and their details are then captured into the system using the web interface in Figure 7.

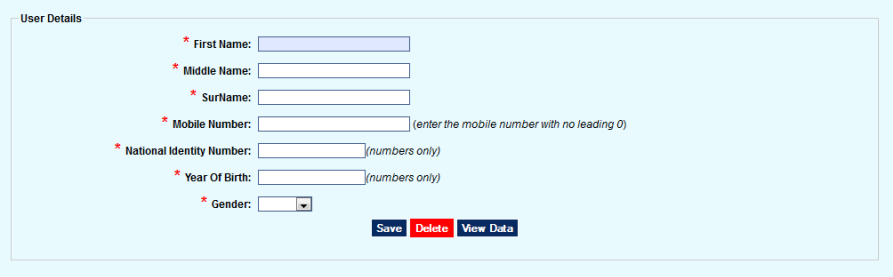


Figure 7: Web interface for user registration

Once the user details are saved, an SMS is sent to the user asking them to confirm their registration as shown in Figure 8. A successful registration is confirmed as shown in Figure 10.

Figure 8: User registration confirmation request SMS

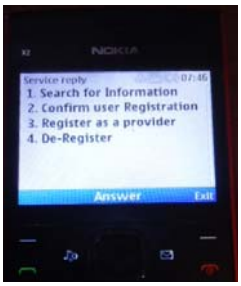


Figure 9: Top Level USSD Menu

Figure 10: User registration confirmation

Upon confirmation they can then proceed to search for information or register as a provider.

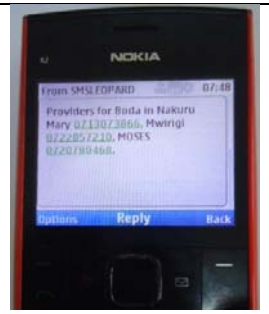
D. Provider Registration Process

Once a user is registered they can then proceed to register themselves to provide a service of their choice.

				
The short code "*384#9870" is used to initiate the use of the system.	The top level menu with four choices is presented to the user.	Provider registration option is number 3.	In case the user is not registered they are prompted to do so first.	The user selects a county.
				
The user selects a location from the list in the county they selected.	The user is prompted to select a product / service category.	The user is prompted to select a product / service from the category they selected.	The user is informed of a successful registration.	

E. Information Search Process

Once a user is registered they can then search for information on the system.

				
The short code "*384#9870" is used to initiate the use of the system.	The top level menu with four choices is presented to the user.	The information search option is number 1.	The user selects a county.	The user selects a location from the list in the county they selected.
				
The user is prompted to select a product / service category.	The user is prompted to select a product / service from the category they selected.	In the event that providers are found the user is notified and an SMS with the names and contacts of the providers is sent to them.	The SMS message that the user receives.	

The identified providers are also notified about the successful information search.

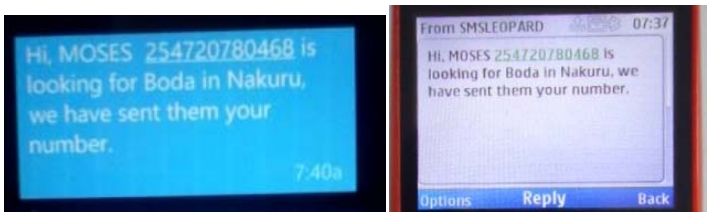
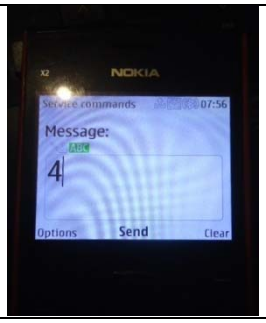
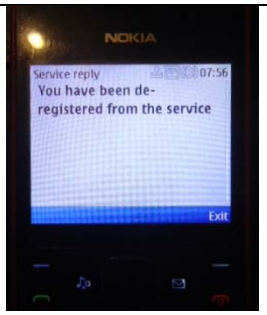


Figure 11: Provider Notification

F. User De-registration

The user is allowed to opt out of the service by following the sequence of steps outlined below. A successful de-registration takes away their ability to search for information as well as removes any products and services that they have registered to provide.

			
The short code "*384#9870" is used to initiate the use of the system.	The top level menu with four choices is presented to the user.	The option to de-register is 4	The user is deregistered from the service

VI. APPLICATION

This system can be used by small and big businesses alike to provide information on services and products to potential clients in instances where applications based on superior technologies are not available or usable. Examples of these situations include cases where the users have mobile phones that only support SMS and USSD. In addition there are times when network conditions may not allow the use of internet and GPS based services.

VII. CONCLUSION

In this paper a location-based mobile advertising model based on the use of SMS and USSD is designed and implemented successfully. The results from the system test show that it is indeed feasible to deliver location-based mobile advertising without having to use relatively advanced technologies such as GPS, Bluetooth, RFID and WAP. In addition, the system is easy to use and can be easily adopted by users of all levels of education and technological backgrounds. The use of technologies that are relatively affordable makes it possible for even small businesses with small revenues to use such a service due to the low cost.

VIII. AREAS FOR FURTHER STUDY

The proposed solution does not deal with the issue of security in the use of the system. Security in this regards refers to the assurance that users require that the persons that they are dealing with, either as businesses offering services or as clients seeking services, are genuine. There is need to extend this model to factor in security features both in the actual technical aspects as well as in the actual use procedures lying outside the system. These could come in the form of user and business registration processes as well as the requirement for a deposit before services are rendered.

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