Proposed Service Providers' Directory using Unstructured Supplementary Service Data [USSD] application platform

by

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Declaration

I, Assah Muzenyi, hereby declare that I am the sole author of this thesis. I authorize the University of Midlands State to lend this thesis to other institutions or individuals for the purpose of scholarly research.

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Approval

This dissertation/thesis entitled "Proposed Service Providers' Directory using Unstructured Supplementary Service Data [USSD] application platform" by AssahMuzenyi meets the regulations governing the award of the degree of BSc. (Honours) Degree Telecommunications

 of the Midlands State University, and is approved for its contribution to knowledge and literal presentation.

Supervisor   …………………………………………………………………………

Date   …………………………………………………………………………..

Acknowledgements

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Abbreviations

USSD-Unstructured Supplementary Service Data

SMS   - Short Messaging Service

GPS   - Global Positioning System

TRAI   -Telecommunications Regulatory Authority of India

SS7   -Signaling System number 7

SMPP -Short Message Peer to Peer protocol

MS   - Mobile Station

BTS   -Base Transmitter Station

MS   C-Mobile Switching Center

HLR   -Home Location Register

MIS   -Management Information Center

VAS   - Value Added Services

CAPEX-Capital Expenditure

OPEX -Operational Expenditure

ID   -Identification

Abstract

The source of contact details of public and private organizations used to be the telephone directory. The telephone directory would contain the physical location of the organization as well as the telephone number. With the advent of the mobile phones whose use has grown exponentially, the fixed network market share has declined drastically. And so is availability of the telephone directory. This proposal is to develop a service provider's directory accessed by mobile phone using the USSD platform.

Keywords: Unstructured Supplementary Service Data [USSD], Service Provider

Chapter 1: Introduction

1.1 Introduction

With more than 13 million mobile phones currently in use in Zimbabwe [1], a mobile based service provider's directory can be developed for the benefit of the business community and the general public. Business can benefit by leveraging the platform as a communication tool, where their customers can get up-to-date contact details about their products and services. Individuals may easily inquire for location, contact details, type and ratings of the services or products. Using a mobile phone one mayestablish a real time session by dialing a specific number.The caller can obtain details of a particular service or product provider from a database application. The businesses or service providers have to register and subscribe to the service, and as such a fee will be charged to businesses on registration and subscribed annually.

This paper focuses on location based service provider directory using USSD technology that is readily available on almost all mobile handsets and on all GSM networks.Unstructured Supplementary Services Data (USSD) allows for the transmission of information via a GSM network. Contrasting with SMS, it offers real time connection during a session. [2] A USSD session is free. USSD allows interactive session between a Mobile Station (MS) and applications hosted by the database Operator. These messages are composed of * digits # keys and allows users to easily and quickly get information of services providers available.

1.2 Background to the Problem

Trying to locate service providersbe it a hotel, golfclub, school or garageinunfamiliar environs could be a challenge. In most cases it has proven to be very difficult even if one does have navigationtools. The challenge usually encountered is that of outdated information which may lead the user to wrong locations

1.3 Aim:

The aim of the project is to create a services providers' directory using USSD application platform.

1.4 Objectives:

- To provide a USSD code for the customers to use

- To connect to the USSD interface

- To give the user the options to drill down and specify requested service

- To retrieve information from the USSD database

- To display the results to the user

1.5 Justification

The USSD directory is needed so as to increase the flexibility of inquiries. In the long run it becomes expensive to ask around for directions than to use the interactive way of locating the service or place. This application is interactive and allows the user to drill down to a specific service or place. Therehave been security issues arising from people looking for directions either at night or in broad day light. It is convenient to inquire for directions after working hours, anywhere, anytime. The user gets the interactive session at zero cost in contrast to the SMS based directory that is billed to the user.

1.6 Scope

Due to security issues the directory could not be tested on live GSMnetworks. Alloperatorswere approached and they all could not allow access to their live network,hence a simulated network isbeing used. It is worth noting that when a USSD code is chosen, it will work across all companies' cellular networks (Netone, Econet and Telecel). This means that this code cannot be used for a different service. And as such there will be need to engage all operators to agree on a single code that will be applicable to all operators.

1.7 Limitations of the project

1. Network operators were not supportive; they all denied access to their USSD gateways

2. Lack of resources for a more comprehensive study and to build a live network

3. Due to confidentiality clauses in the company policy some participants were unwilling to provide information about their network configuration and set-up.

4. Current thrust of Zimbabwe being a consumer of finished goods did not help as well. All telecoms companies do not have Research and Development hence no source of information or interest.

1.8 Resources

1. Laptop
2. XAMPP
3. PHP

Chapter 2: Theoretical Aspects

This chapter focuses on the available technology that may be utilized to implement the directory

2.1 Global Positioning System [GPS]

This is a position locating system that is based on satellites. A mobile device which is equipped with a GPS receiver is capable of providing location and time data in all weather conditions at any given time provided it's locked to at least four satellites. [2.3] GPS application includes military and commercial capabilities which are accessible freely by anyone with a GPS receiver. The system is run by the United States Government. [3]

2.1.1 GPS Concepts

GPS satellites continuously transmit signals containing the time the message was transmitted and the position of the satellite when the signal was transmitted. Using the received message the receiver can determine the transmit time and compute the distance to the satellite. The distances to the satellites and satellites positions are used to drive the exact GPS receiver position using navigation equations. The location is displayed showing the latitude, longitude and a moving map.A Navigator, which is a more specialized GPS, would display road and special Geographical icons that would have been pre-loaded into it. [3] GPS can display derived information such as speed and direction calculated from positional changes. It provides time that compares favourably with an atomic clock [4]

The GPS system consists of three sections namely Space Segment [SS], Control Segment [CS] and User Segment [US]. The SS and CS are developed and maintained by the US government. The SS is made up of 32 orbiting GPS satellites in constellation as of December 2012.the more satellites the better the precision. CS is made up of two master control stations, four dedicated ground antennas and six dedicated monitor stations. [3]User Segment is free and depends on the user's application. GPS can be used for timing purposes in synchronization of telecommunications sites. It can also be used for tracking purposes where the receiver is fitted on the device to be monitored and the device position can constantly be monitored. The device can

be wildlife, motor vehicle, aircraft, emergency vehicle, cell phone. The tracking devices are always fitted with GPS receiver and Software that transmit the exact position and time to the control center.GPS mapping and Navigation are the most common application of the GPS system. With the aid of the GPS coordinates and navigation software one can be able to locate a place and find the best route to the destination. [4]Remote sensing provides a cheaper and real time method mapping and monitoring of vast areas. A product such as Google Earth enables users to view remote areas anywhere on earth. The user can actual zoom into the complex to get a clearer view and get physical address of the area. The applications of the GPS continue growing, driven by the favourable drop in prices of user devices coupled by improved accuracy. Though originally designed for military applications the commercial purposes have far exceeded the former. [4]The major weakness of the GPS navigation system is that it does positional information which depends on the preloaded maps. Also the GPS cannot work where there is no clear line of site hence not usable indoors. Google maps provide more precise information of business location and contact details but the devices are not readily available to the general population compared to cell phones.

2.2Short Messaging Services (SMS)

This is an application available on GSM networks which enables mobile phones to send text messages to each other. The messages are limited to a maximum of 160 characters hence thus referred to as 'Short'. The system uses store and forward transmission model, which allows a message to be stored briefly if the receiving phone is not available. The two way transmission model uses an SMS Center [SMSC] to store and forward messages. Most GSM handsets are capable of sending and receiving SMS which can be send to or from any network anywhere. MS was first used commercial in 1992 by Vodafone in United Kingdom. It was used by the network to inform its customer of the voicemail messages. The SMS became so popular due to its simplicity and low cost, to the extent that by December 2010 7 trillion messages had been send worldwide. [2,7].The service became so popular that marketers in India took the advantage of the platform by bombarding users with unsolicited messages to the extent that TRAI (Telecom Regulatory Authority of India) imposed a volume cap of 6000 messages per month per subscriber. This can be broken down to a daily limit of 200 messages per day. [6]

2.2.1Typical SMS applications are:

➢ Consumer applications that is mobile to mobile texting

➢ Interactive broadcasts-news, weatherforecast, more recently Malaysia Airline MH370 disappearance news to passenger relatives.

➢ Location based service

➢ Corporate applications update e g Zimbabwe passport office advices the applicants through SMS when the passport is ready for collection.

➢ Mobile Service providers updates- SIM card updates and network configurations [2]

2.2.2 The main limitations of the SMS are:

➢ Messages have to be explicitly typed before being send

➢ Each message can only be up to 160 characters

➢ Inability to transmit non-text data

➢ Every message transmitted is billed to the user [2]

Two of the limitations listed above, explicitly typing of message and cost to the user, can be addressed by using USSD in place of the SMS.The thrust of this project is to investigate the feasibility of using USSD platform to create a Service Provider Directory.

2.3 USSD [Unstructured Supplementary Service Data]

Due to intense competition in the mobile telecom industry, decline in voice traffic and advent of mobile data, more and more operators turn to Value Added Services (VAS) for survival. Operators had to look for faster and cost effective technologies to transact. Thus USSD technology is the answer to all this**.**USSDis a session based protocol used by GSM mobile phones to communicate with a remote computer application. It uses Signalling System number 7 (SS7) to transmit bidirectional data between mobile phone and application device. [7] It provides real time session between the mobile deviceand application server.It supports interactive real time session without blocking voice and data communications. Because there is no store and forward hence the USSD is 7 times faster than the SMS.The operations of the USSD system are Handset and SIM card independent.

2.3.1 Applications of USSD technology are:

- ➢ Banking services-money transfers, transactions update
- ➢ Prepaid recharging and balance enquiries
- ➢ News and sports updates
- ➢ Telephone directory and yellow pages
- ➢ Voting and polling
- ➢ Emergency information
- ➢ Marketing ,advertising and promotional activities

2.3.2 USSD Architecture

Figure 1 shows the block diagram of the USSD system architecture. The Mobile device MS initiates a session during a pull mode operation. A session number is allocated and resources are availed between the server and mobile for the duration of the session. Because USSD uses the signalling channel it means a session can voice and data communications can be done simultaneously.

MS – This is the mobile phone/user device

BTS –Base Transceiver Station, provides the air interface to the MS

From Figure 1, shows the Ussd architecture composed of the Mobile Switching Centre (MSC). Its central point of the system and provides switching and authentication services. The authentification is done throughHLR and VLR.The switch directs the USSD request to the USSD Gateway through SS7 (Signaling System number 7).The connection between the external applications and the USSD gateway is through SMPP (Short Message Peer to Peer) protocol used for sending text data over internet. The USSD session does not go through the billing block made up of CDR for postpaid customers and PREPAID IN for prepaid customers. [8].generally the USSD functionality is implemented in the following modes:Pull Mode, which handles Mobile phone Initiated USSD Requests. This is done by dialing * some digits then # for example *100# and the Push Mode which handles network Initiated USSD Requests.
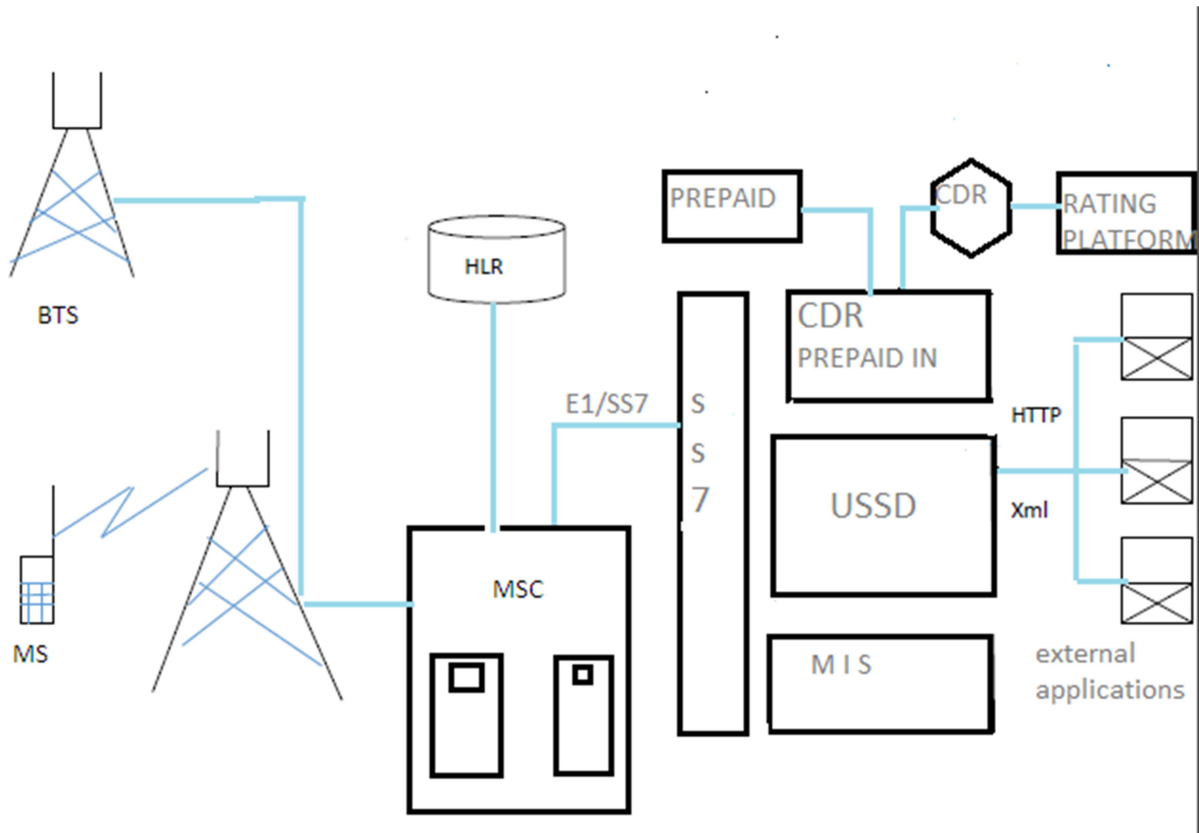
Figure 2.1: Block diagram of a USSD architecture [8]

SMS	USSD
Mobile station to Mobile station [MS]	Mobile station to application server
Transaction charged to MS	No charge to MS
Slow due to store and forward process Duration of transmission 14 seconds	Seven times faster than SMS Duration 2 seconds
Store and forward process	Real time session
Compatible with most mobile handsets	Available on most MS
Explicitly typed text messages	Drill down process to required application or facility
Messages are stored on MS	Session record not kept by MS
SMSC used to store and forward message	No any other hardware is involved once the session is established
Uses SS7 protocol	Uses SS7 protocol
Received message can be stored by the mobile phone	Uses flash type message which cannot be stored

Table 2.1: Comparison of SMS and USSD

2.3.3 Billing

Billing can be implemented based on the number of menu transactions handled, time spend browsing or session duration and or a once off charge. Billing requires more complex Rating platform hence most operators prefer to recuperate their costs through VAS products. [8]

2.3.4 Conclusion

Since USSD platform uses already existing SS7 protocols meaning less CAPEX and OPEX.The platform can host multiple VAS applications. The session does not impede other communications hence improved resource utilization. The fact that USSD technology has a zero cost to the user also improves traffic on VAS products which in turn improves revenue. Hence for this directory service USSD technology was preferred ahead of the SMS.

Chapter 3.Methodology

3.1 Introduction

Methodology is the formal step by step procedure undertaken for the purpose of obtaining credible research data. Each activity transforms information in a manner that ultimately results in validated research data.This whole system was developed in PHP and it implements the MYSQL database to store the requests that are done by the users. The code that implements the USSD is given below.

Code Snippet

```php
1   <?php
2
3   ini_set('error_log', 'ussd-app-error.log');
4
5   require 'libs/MoUssdReceiver.php';
6   require 'libs/MtUssdSender.php';
7   require 'class/operationsClass.php';
8   require 'log.php';
9   require 'db.php';
10
11
12  $production=false;
13
14      if($production==false){
15          $ussdserverurl ='http://localhost:7000/ussd/send';
16      }
17      else{
18          $ussdserverurl= 'https://api.dialog.lk/ussd/send';
19      }
20
21
22  $receiver   = new UssdReceiver();
23  $sender     = new UssdSender($ussdserverurl,'APP_000001','password');
24  $operations = new Operations();
25
26  $receiverSessionId = $receiver->getSessionId();
27  $content            =   $receiver->getMessage(); // get the message content
28  $address            =   $receiver->getAddress(); // get the sender's address
29  $requestId          =   $receiver->getRequestID(); // get the request ID
30  $applicationId      =   $receiver->getApplicationId(); // get application ID
31  $encoding           =   $receiver->getEncoding(); // get the encoding value
32  $version            =   $receiver->getVersion(); // get the version
33  $sessionId          =   $receiver->getSessionId(); // get the session ID;
34  $ussdOperation      =   $receiver->getUssdOperation(); // get the used operation
```

```php
52      try {
53
54          $sessionArrary=array( "sessionid"=>$sessionId,"tel"=>$address,"menu"=>"main","pg"=>"","others"=>"");
55
56          $operations->setSessions($sessionArrary);
57
58          $sender->ussd($sessionId, $responseMsg["main"],$address );
59
60      } catch (Exception $e) {
61          $sender->ussd($sessionId, 'Sorry error occured try again',$address );
62      }
63
64  }else {
65
66      $flag=0;
67
68      $sessiondetails=  $operations->getSession($sessionId);
69      $cuch_menu=$sessiondetails['menu'];
70      $operations->session_id=$sessiondetails['sessionsid'];
71
72      switch($cuch_menu ){
73
74          case "main":   // Following is the main menu
75              switch ($receiver->getMessage()) {
76                  case "1":
77                      $operations->session_menu="Harare";
78                      $operations->saveSesssion();
79                      $sender->ussd($sessionId,'Enter Your ID',$address );
80                      break;
81                  case "2":
82                      $operations->session_menu="Bulawayo";
83                      $operations->saveSesssion();
84                      $sender->ussd($sessionId,'Enter Your ID',$address );
85                      break;
```


Table 3.1: The system session database.

One table stores sessions and the other table stores the Service Providersdetails that would have subscribed to the USSD Application.

3.2 Procedure[Simulator initiation]

1. Go on start button enter "cmd"

2. Minimise the screen of cmd and go to C: /users/altimatecomm/ideamart simulator v 2.3.0/bin

3. Copy path on address bar, copy'ideamart simulator v2.3.0/bin'

4. Go back to command screen and enter 'cd'

5. Leave space and paste ' ideamart simulator v2.3.0/bin'

6. Press enter

7. Enter 'sdp-simulator console'

8. Press enter and the console start running

9. Minimize and go to Mozilla

10. On a new tab write 'localhost:1001'to start the simulator

11. Switch to USSD from the default SMS

12. Change the URL by going to new tab and enter local

13. Take any PHPAPI master

14. Click on ussdap.php

15. Copy the URL link and paste it on simulator URL.

The simulator is up now and ready

Name	Description	City	Service		
Holiday Inn	17 Samora Machel, Tel 581001	Harare	Hotel	Edit	Delete
President Hotel	20 Nelson Mandela 4536772	Harare	Hotel	Edit	Delete
Holiday Inn	12 Robert Mugabe Way	Bulawayo	Hotel	Edit	Delete
Christmas Pass	4 Tema Road Tel 391011	Gweru	Hotel	Edit	Delete
Holiday Inn	10 Morale Way Tel 10288	Mutare	Hotel	Edit	Delete
Chelsa Bar	10 Joshua Nkomo Street	Harare	Sports Bars	Edit	Delete
Autoworld	6 Rus Ave Tel 30910535	Mutare	Garage	Edit	Delete
Debak	Cnr 3rd Avenue and Main Street tel 390786	Bulawayo	Garage	Edit	Delete
Barclays	10 Harare Street	Harare	ATM	Edit	Delete
Barclays	10 Mandara Ave	Gweru	ATM	Edit	Delete
FBC	CNR main st/6th avenue	Mutare	ATM	Edit	Delete

Add Entry
Delete All Sessions

Table 3.2: Table for entering Service Provider's details

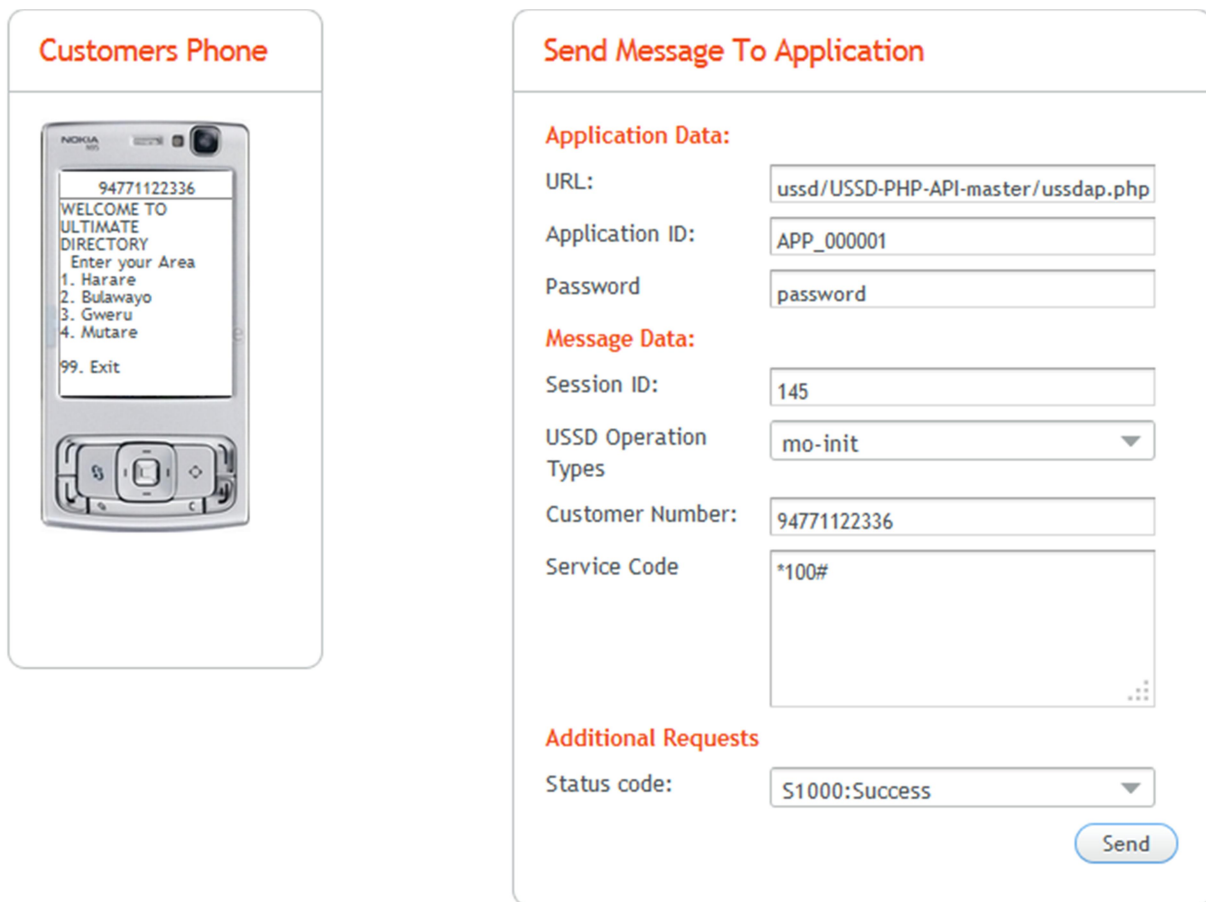## 3.3 Service Provider inquiry Session

1. A unique session ID is assigned

2. For a mobile phone initiated pull session, USSD operation types –select 'mo-init'

3. Customer number does not matter.

4. Enter service code *100#

5. Click send and wait for the results to be displayed on the customer phone

6. To select one of the options on the menu go to step 2 and select 'mo-con'

7. Go to step 4 and enter the selected city. Or 99 to exit/abort

8. To select service go to step 4 and enter service code 1 for hotels

9. A list of available resources/hotels is pulled down.

10. Once a wrong option is entered the session is aborted and a new one has to be re initiated.

11. A new session ID has to the allocated

Chapter 4: Results

This chapter will focus on the results and objective realisation of this project. The chapter also focus on the system output. It dwells on the screen dumps of the system to demonstrate theobjective realisation.
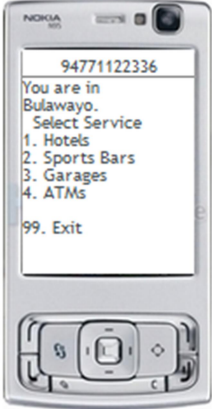

Figure 4.1: USSD pull mode showing cities available.

In this screen dump we see a user sending a USSD code *100# and requesting. The USSD application replies back with a Welcome message. The user upon the message selects the location and send back to the USSD application server.

Customers Phone

94771122336
You are in Bulawayo.
  Select Service
1. Hotels
2. Sports Bars
3. Garages
4. ATMs

99. Exit

Send Message To Application

Application Data:

URL: ussd/USSD-PHP-API-master/ussdap.php

Application ID: APP_000001

Password: password

Message Data:

Session ID: 145

USSD Operation Types: mo-cont

Customer Number: 94771122336
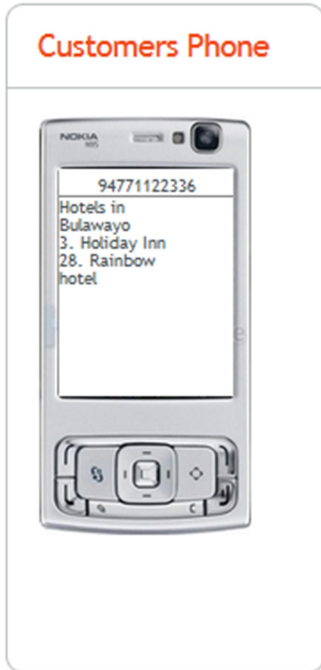
Service Code: 2

Additional Requests

Status code: S1000:Success

Send

Figure 4.2: Available services in Bulawayo

The user receives a menu with available service options and prompted to select a hotel.

Customers Phone

94771122336
Hotels in
Bulawayo
3. Holiday Inn
28. Rainbow
hotel

Send Message To Application

Application Data:

URL: ussd/USSD-PHP-API-master/ussdap.php

Application ID: APP_000001

Password: password

Message Data:

Session ID: 145

USSD Operation Types: mo-cont

Customer Number: 94771122336

Service Code: 1

Additional Requests

Status code: S1000:Success

Send

Figure 4.3:Hotels in Bulawayo

Figure 4.4: Details of a selected hotel

Messages sent to Customer

Time	Phone #	Message
05:31:50	94771122336	WELCOME TO ULTIMATE DIRECTORY Enter your Area 1. Harare 2. Bulawayo 3. Gweru 4. Mutare 99. Exit
05:32:06	94771122336	You are in Bulawayo. Select Service 1. Hotels 2. Sports Bars 3. Garages 4. ATMs 99. Exit
05:32:30	94771122336	Hotels in Bulawayo 3. Holiday Inn 28. Rainbow hotel
05:33:46	94771122336	Cnr G.Silundika & 10th avenue,rating ***,BB-US$ 90-140pp

Clear All

Messages sent to Application

Time	Phone #	Message	Status
04:04:49	94771122336	*100#	SUCCESS
04:05:16	94771122336	2	SUCCESS
04:06:51	94771122336	*100#	SUCCESS
04:07:34	94771122336	1	SUCCESS
04:10:10	94771122336	99	SUCCESS
04:42:41	94771122336	99	SUCCESS

Clear All

Figure 4.5: log of session activities

Chapter 5: Conclusion

This chapter looks at the recommendations and conclusions of this work.

Objective	Status
To provide a USSD code for the customers to use	Achieved
To connect to the USSD interface	Achieved
To give the user the options to drill down and specify requested service	Achieved
To retrieve information from the USSD database	Achieved
To display the results to the user	Achieved

Table 5.1: Objective validation Table

5.1 Recommendations

Given ample time this project can be built into a very huge and multi-functional directory. This project can be launched commercially to compete with Econet's mobile directory launched recently which uses SMS platform. It is my intention to mobilise resources and register the patent for this directory.

I recommend further researchon incorporating Google maps and language options. This will in turn help the user of the application not only to call the service providers but also to find the directions to the requested destination.

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