

# Design of a GSM Based Information System for Disease Outbreak Reporting

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## Abstract

The present method of reporting cases of Highly Pathogenic Avian Influenza via telephone hotline to NVRI has proven not to be as effective as required considering the need for timely reporting and response to outbreaks. In order to improve response time, accessibility, provide proper documentation of queries and reduce the financial burden on the average farmer, the researchers have taken advantage of the GSM network which has a coverage of over 46% (NCC<sup>1</sup>, 2009) of the Nigerian population as at April, 2009 and has infrastructure which is not limited to the urban areas but has also permeated the rural areas to a reasonable extent. The aim of this project is to develop a system that can widen access to electronic databases by use of GSM phones. This would enable small scale rural farmers to have access to the Internet and online Nigerian databases. To achieve this purpose the researchers have created a gateway between the GSM and computer networks. They have also created an SMS message format which is able to interrogate the existing database. Visual Basic 6 was the main programming tool used in designing the system. Nokia PC Connectivity 3.0 SDK and Nokia PC Suite 7.1 were functional requirements for the system to be implemented. A Nokia 7210 Supernova handset was connected to the computer system via USB to serve as the Modem.

**Key Words:** Highly Pathogenic Avian Influenza, NVRI, GSM network, SMS, Visual Basic 6

## Introduction

The telecommunications industry in Nigeria has undergone a revolution since the liberalization of the sector. Supported by the programmes of the independent regulator; the Nigerian Communications Commission (NCC), the sector has seen robust growth driven largely by the entry of mobile operators into the market since 2001. Tele-density has risen from 0.73% in 2001 to 45.93% in 2008 (NCC<sup>2</sup>, 2009) and then to 47.98% in April, 2009 (NCC<sup>1</sup>, 2009). The market is seeing record leaps of investment.

There has also been an explosion of information with the introduction of the Internet with its capability to aggregate information from different sources which include but are not limited to electronic databases and files stored in diverse computers. However, access to these information sources is limited by access to the computer and Internet connection. The Global System for Mobile communication (GSM) digital telephone technology for mobile phones has become one of the most popular technologies as it accounts for 85% of the world's mobile market (GSMA, 2008). As at April, 2009 the GSM network had a coverage of 46% of the

Nigerian population (NCC, 2009).

The outbreak of Highly Pathogenic Avian Influenza (HPAI) in January 2006 (NVRI, 2009) has continued to spur interest and activities within the country and internationally. National Veterinary Research Institute (NVRI) has been at the centre of these activities particularly where laboratory analysis of suspected cases for rapid diagnosis and prompt control is concerned. From 1<sup>st</sup> of January 2007 till date, over five hundred and twenty (520) pathological samples from suspected cases were received from 36 states of the Federation including FCT (NVRI, 2009). These include tissues, tracheal/cloacal swabs and sera samples. The samples were taken from avian species of local free range and commercial intensively reared chickens, turkeys, ostriches, guinea fowls, ducks, emus and geese. The National Veterinary Research Institute (NVRI), Vom is the main organisation in West and Central Africa with the capacity to deal with these pathological samples.

Presently, the only means by which the NVRI gets alerts of Highly Pathogenic Avian Influenza (HPAI)

outbreak in Nigeria is via a telephone hotline which is in the custody of staff. This method has proven not to be as effective as required considering the need for timely reporting and response to outbreaks. There is therefore a need to develop a more effective method to afford farmers the opportunity to report outbreaks directly to the NVRI database and obtain timely response from the database.

The convergence of the GSM network and computer networks would widen access to Internet and computer databases via Short Messaging Service (SMS) to the rural farmer. This convergence would bridge the digital divide that exists between urban and rural Nigeria in general and the rural farmers and NVRI in particular.

### Background of the Study

With the shrinking of the world due to the introduction of the Internet, there has been an increasing need to provide access to the Internet to rural farmers of both crop and livestock. In Nigeria, as with many developing nations access to the Internet and online databases is limited majorly to the urban areas and to those who can afford its relatively high cost. Due to the limitation of majorly to urban areas, exorbitant prices of computers and peripherals to connect effectively to the Internet and high tariffs of Internet access, it has become imperative to find alternative access to the information on the Internet and these online Nigerian databases.

The GSM network has coverage of over 46% (NCC<sup>1</sup>, 2009) of the Nigerian population as at April, 2009 and has infrastructure which is not limited to the urban areas but has also permeated the rural areas to a reasonable extent. It has the potential to bridge the digital divide that exists between urban and rural dwellers. Most rural farmers can afford to buy a GSM handset and with limited knowledge can understand how to utilize it as against a computer system which is expensive to purchase and needs specialized software and training to effectively use.

In order to harness the benefits of the GSM network, the intention of this study is to use the SMS service of the GSM digital telephone technology to facilitate quick and timely reporting of Highly Pathogenic Avian Influenza (HPAI) outbreaks on farms to the NVRI database. This will be done by establishing a link between the GSM network and a computer system.

### Aims and Objectives

The aim of this project is to develop a system that can

widen access to electronic databases by use of GSM phones. This would enable small scale rural farmers to have access to the Internet and online Nigerian databases.

The objectives of this project include:

1. To create a gateway between the GSM and computer networks.
2. To format SMS message to be able to interrogate the existing database.

### Justification

Building a value added network out of the existing GSM networks would contribute towards bridging the digital divide between those people who have access to the computer network and those who do not, but have access to GSM networks. This would give them the capability of accessing the much needed data and information that has been aggregated by various Nigerian service organizations and other computer based networks without necessarily owning a computer or having direct access to these networks via a computer system. This GSM based online information system would provide access to farmers who would want to report Highly Pathogenic Avian Influenza (HPAI) outbreaks on their farms. The information system would provide cheaper and faster access to the NVRI database for these farmers who have easy access to GSM phones. Easily accessible and timely information is essential in the management of Highly Pathogenic Avian Influenza (HPAI). This is because the endemic nature of the virus makes it imperative for quick and timely response to stem further spread. The preference for the SMS service of the GSM telephone technology to voice is based on the need to remove most of the human intervention in reporting and response to Highly Pathogenic Avian Influenza (HPAI) outbreaks and reducing the cost of reporting on the farmer since it is cheaper to transfer messages via data than via voice. An on-line system will be able to attend to a lot more reports in real or near real time.

The preference of the GSM handset rather than a computer system for access to the NVRI database by farmers is deliberate because of the following factors:

1. Inadequate power supply to power computer systems.
2. Most small scale farmers cannot afford to own a computer system.
3. Most rural areas don't have adequate infrastructure for affordable connection of a computer to a Wide Area Network (WAN).

The growth of the GSM network has been so rapid that Nigeria has been rightly described in various fora as "one of the fastest growing mobile markets in the world" (Uguma, M.N. et al 2005). According to NCC data, as at April, 2009 overall active subscriber lines peaked at 67,178,465 lines with the GSM sector in unrivalled dominance of the telecoms market with 58,063,300 lines while mobile CDMA sector follows with 7,724,480 lines and fixed wireless sector with 1,390,685 lines. It will therefore be an incentive to provide an alternative way to access all the important information aggregated on electronic databases via the GSM network. Even many subsistence farmers can afford to own and maintain a GSM enabled handset, this would be an effective way of solving this problem.

**Scope of the study**

Specifically, this project will be limited to developing an interface to the Animal Disease Reporting Database (ADRD) of the National Veterinary Research Institute, Vom. The scope of this study will be limited to developing a communication link to the ADRD of NVRI through the GSM network.

**Description of Existing System:**

**Processes/Operations**

The present method of information dissemination in the Avian Influenza unit is outlined below:

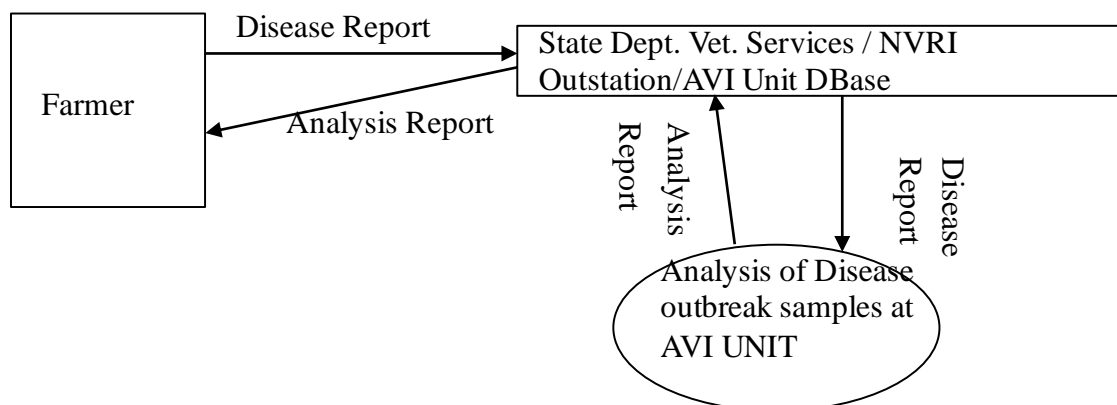
1. In the case of any suspected outbreak on a farm, the farmer either makes a phone call to

the state Department of Veterinary Services or the NVRI Outstation closest to the farm. The State's Department of Veterinary Services or the NVRI Outstation will then make a call to the Avian Influenza Hotline which is with the Officer-in-Charge of the Avian Influenza Unit. The Farmer can also make a direct call to the Officer-in-Charge of the Avian Influenza Unit.

2. On receipt of the call, the Officer-in-Charge of the Avian Influenza Unit asks basic questions to ascertain the nature of the outbreak and then proceeds to request for samples from the farm. Basic information about the farm and the nature of the outbreak are entered into a database manually.
3. Samples are then sent to the Avian Influenza Unit of the NVRI where they are analysed.
4. The results of the analysis and other necessary steps to contain the outbreak are then communicated to the farmer via phone directly to the farmer or through the Department of Veterinary Services or the NVRI Outstation closet to the farm.

**Data Flow Diagram**

Data flow diagrams are used to describe how the system transforms information. They define how information is processed and stored and identify how the information flows through the processes. It is also described as a graphical representation of the "flow" of data through an information system.



**Fig. 1 Data Flow Diagram of NVRI Avian Influenza reporting system**

**Shortcomings of Existing System**

The staff responsible for receiving disease outbreak reports e.g Officer-in-Charge Avian Influenza Unit may not be accessible at all times due to circumstances beyond the staff's control which include

and are not limited to the following:

- Indisposed due to medical reasons
- Inability to receive calls when the officer is asleep especially at night.
- Poor signals during calls which could cause

inaccurate information to be disseminated.

- Inability to receive calls when the staff does not have possession of the disease reporting hotline.
- Inability to receive calls when the staff's phone is not charged or switched off.
- Phone calls could be quite expensive especially for a long discussion e.g report a disease outbreak on a farm
- Inability to receive accurate information when the environment is not conducive e.g. in a public place, noisy place
- In a case where the disease outbreak report has to pass through a third party like the State department of Veterinary Services , the information may have been distorted due to human error.
- The staff responsible for receiving disease reports has to manually document the information into a database. This process takes time.

### **Proposed Design Alternative**

This study suggests only one design alternative to the existing system which is to facilitate the transfer of information from the Farmer to the Avian Influenza Unit and vice versa via SMS instead of via phone calls. This will be achieved by establishing a link between the GSM network and a computer system capable of processing the information received via SMS from the GSM network and eliciting relevant responses via SMS from the Animal Disease Reporting Database (ADRD) on the NVRI network.

### **User Interface Requirements**

The main medium of sending inputs and receiving outputs from the information system will be via a GSM Phone. Any GSM phone would suffice for this purpose. A predefined message format would have to be used in inputting data into the system via SMS from an external mobile phone. Also, the output would be received via SMS in the same message format.

### **Processing Requirements**

The input message composed using a specified format would be sent via SMS to the GSM phone modem connected to the computer system that houses the information system and ADRD. The system retrieves the incoming message from the modem's inbox and then converts it to the appropriate SQL statements which would be used to query the ADRD. The

responses would be formatted using the specified message format and sent via SMS as output to the requesting GSM phone.

### **Control Requirements**

A specified format would be used to compose both input messages and output messages. An administrator password would be needed to access the information system.

### **Tangible Benefits**

1. Most of the human intervention in the reporting of Avian Influenza outbreaks would be eliminated.
2. Data is used rather than voice to transfer information between the farmer and NVRI. This is cheaper alternative because transfer of data is cheaper than voice.

### **Organizational Feasibility**

The new system would increase the capability of NVRI to respond to Avian Influenza Outbreaks more effectively and efficiently.

### **Economic Feasibility**

- It would reduce the amount of money farmers spend in reporting Avian Influenza outbreaks on their farms because of the affordable prices of GSM handsets and the cheap rate of the SMS over the GSM network.
- It would also reduce the operational cost of responding to Avian Influenza outbreak reports by NVRI.

### **Technical Feasibility**

The hardware and software needed to implement the system can be easily sourced locally from reputable and reliable vendors. Guarantees on the hardware is also available. Maintenance for the hardware and software can either be done by staff of the NVRI or outsourced to local reputable firms.

### **Operational Feasibility**

The new system would be easy to use by both the farmers and the NVRI staff. Farmers would be trained on how to send specially formatted SMS and also understand the contents of specially formatted SMS. Staff of the Avian Influenza Unit of NVRI would be trained on how to retrieve data from and update data to the ADRD.

### **Description of the new system**

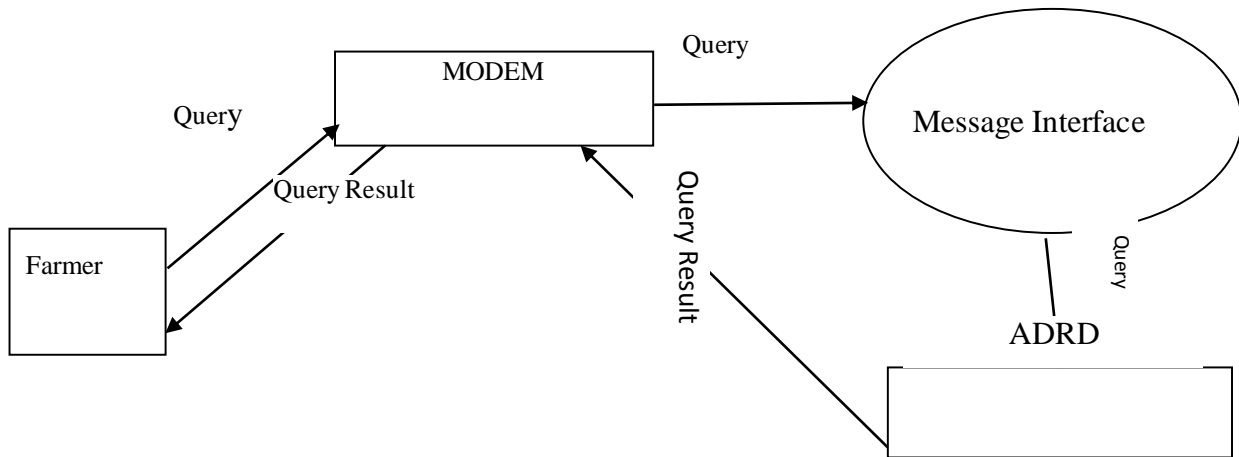
The Nokia 7210 Supernova Handset was connected via

a USB cable to the Intel(R) Core computer system to act as the modem for the new information system. The system has the following functions:

1. Input: Pre formatted SMS messages are received from an external handset and stored in the Nokia 7210 Inbox. The system retrieves

these messages and stores them in the ADRD database. The messages are then converted to the appropriate SQL statements to query the ADRD.

2. Output: The appropriate responses are converted to the appropriate SMS statements.



**Fig. 2 Data Flow Diagram for GSM Based Online Information System**

**User-Interface Design:**

**User**

A message format would be created to input data via SMS and the responses from the information system would be formatted using the same message format.

Incoming SMS messages would be formatted thus:

1. A keyword “Disease Outbreak Report” would form the header for each message. This would be recognized by the system as a disease report needing a response.
2. The body of the message will have the following fields: Farm location, symptoms, time outbreak was first noticed, number of animals affected, number of animals dead.

Outgoing responses would be formatted thus:

1. A keyword “Preliminary Outbreak Report” would form the header for each response message.
2. Possible disease, Probable causes, First aid measures, request for samples.

**Administrator**

For the purpose of sending information to select multiple users a user-interface is necessary. The system contains the following controls:

1. Textboxes for inputting destination phone numbers separated with a coma, Service centre number e.g. Glo, MTN e.t.c. and the content of the message.
2. Command buttons for sending the information contained in the text boxes to users.

**Hardware Specifications**

s/no	Hardware	Justification
1	Duo Core, 1.66 GHz processor (Laptop)	For high speed processing of input queries and corresponding output information. A laptop is used because it guarantees mobility and portability.
2	160 GB Hard Disk	For storage of ADRD database and information system software
3	1GB Memory	For quick processing of information
4	Nokia 7210 Supernova fitted with SIM Card	Phone is compatible with Nokia PC Connectivity SDK 3.0. The SIM card enables system to establish connection with other phones on a GSM network

**Software Specifications**

s/no	Software	Justification
1	Windows XP Operating System	Very robust Operating System, good security features
2	Nokia PC Connectivity SDK 3.0	Sophisticated easy-to-use application programming interface for developing applications for Nokia mobile phones
3	Nokia PC Suite 7.1	Sophisticated easy-to-use interface for Nokia mobile phones

**Modularization**

The GSM based online information system is made up of several main modules, these *main modules* comprise of several *sub modules*.

S/NO	MAIN MODULE	SUB MODULE	FUNCTION
1.	FrmSMS	FrmRead	Reads incoming SMS messages from clients.
		FrmSend	Sends outgoing SMS messages to clients.
2.	FrmSend	Form_Load	This form automatically loads the Nokia references that were enabled for SMS.

		Form_Unload	This form unloads the Nokia references that were enabled and loaded for SMS.
		SendSMS_Click	This module sends outgoing SMS from the system to the client.
3.	FrmRead	Form_Load	This form automatically loads the Nokia references that were enabled for SMS.
		Form_Unload	This form unloads the Nokia references that were enabled and loaded for SMS.
		ReadSMS_Click	This module reads incoming SMS from clients.

**Conclusion**

The GSMOnline will certainly widen access to electronic databases by use of GSM phones. This would enable small scale rural farmers to have access to the Internet and online Nigerian databases of which the ADRD is an example. It would be a more efficient and cost effective way of reporting Highly Pathogenic Avian Influenza in Nigeria. The wide coverage of about 46% (NCC<sup>1</sup>, 2009) of the GSM network and the cheap rate of sending SMS is a good incentive for the average Nigerian farmer to use the system. The system should also go a long way in helping to mitigate the effect of Highly Pathogenic Avian Influenza in Nigeria by facilitating timely reporting of the disease.

**Recommendations**

The researchers make the following recommendations for further studies:

1. The GSMOnline still has connectivity problems. It is not able to implement the Nokia 7210 Supernova mobile phone as a Modem. It is suggested that more work in this area has to be done.
2. At present GSMOnline still needs some level of human intervention to query the ADRD, a possibility of reducing the level of human intervention especially in eliciting response from databases should be explored.
3. Presently a particular brand of mobile phones i.e. Nokia can be used as a Modem for GSMOnline. The possibility of using other brands of mobile phones should be explored.
4. Presently GSMOnline was developed and can only run on the Microsoft Windows Operating System platform. The possibility of using and developing an open source version should be pursued.

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