Gsm Based Vehicle Inspection and Verification System

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Abstract

GSM Based Vehicle Registration system is a system that helps in the verification and inspection of road worthy cars and it is also used to track stolen vehicles by accessing the motor licensing database wirelessly. The system is made up of a user's mobile phone, a GSM modem interfaced to a PC through as serial port, the PC is functioning as a server, and a software developed in VB.NET. A Table Adapter is included, a relational database used was created using an MS-Access and database access codes were written in Structural Query Language. Users send Query to the GSM Modem attached to the PC, with the help of an application software that was developed. The modem helps the PC to access the query through AT Commands. An SQL Query is used to access the database for a fitting response.

The project is suitable for a broad range of applications on wireless database access as it can be applied in various areas of human life. The software can be customized to fit in any organization. A University student can use it to check for his/her result wirelessly. It could be used to track fake drugs by the drug administrators. It could be used in the library to make enquiry of any type of book. Generally, it is used to access data wirelessly anywhere, anytime, even locations outside the country that has a GSM coverage.

KEYWORDS: GSM, VEHICLE, INSPECTION, VERIFICATION, SYSTEM.

1. Introduction

GSM Based Vehicle Inspection and Verification System is a system that will enable the Vehicle Inspection and licensing staff to check for the genuiness of vehicles that are road worthy because all the new vehicles bought or brought into the country must go through the vehicle inspection and verification offices. Many vehicles on the road are stolen cars and the documents are duplicated or manipulated, there are also vehicles that are not road worthy but they are still on the road, these normally lead to accidents.

We are in the era of information explosion where information is needed in our everyday life. More vehicles keep on coming every day increasing the registration and inspection workload and complex data access problems. The information keep on increasing spontaneously calling for the need for effective, precise and concise control and database access. There is need to access data stored in remote branches or central office of vehicle registration or inspection offices at a reduced cost, at any point in time and anywhere around the globe even without the need to have internet connection, once there is GSM network coverage within that area. When a user queries about the particulars of a vehicle, the system receives it as SMS, interprets it and uses its content to query the database to find out the correct particulars of the vehicle in question. If there are particulars of such a car in the database, the system will return back all the details of the vehicle with such identity but if there is none, the system will tell the user that no such car exists in the database.

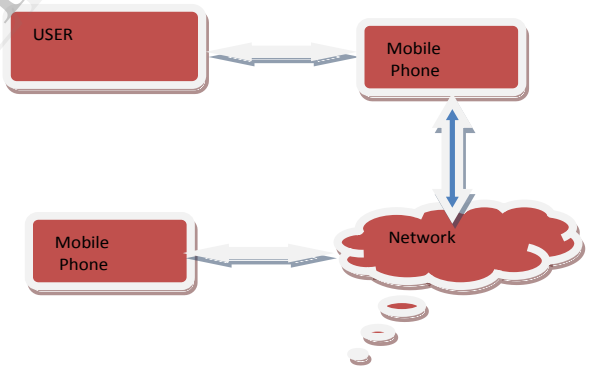

Fig 2: Block Diagram of the Project

1.2 System Capabilities

The system is be able to achieve the following at the end of the project:

- Accept and translate the content of the SMS messages sent by user.
- Use the content of the SMS to query the database system based on the information the user is looking for, ensuring corporate information availability just in time using mobile phone
- Then sends back the information to the user.
- Reducing cost of manual processing in vehicle registration offices worldwide.

1.3 Scope of the Work

These involves the transmission and interpretation of SMS queries from the sender to the receiver through a GSM Mobile terminal where the sender and receiver devices are the mobile phones. The database is embedded in a computer system which serves as the server through a serial port. If an SMS query is sent through the mobile phone to the modem, the system interpreters it using AT Commands and the program scoops the required information from the relational database.

1.4 Significance of work

Benefits occur to the staff and also the organization.

At the staff level, it provides employees opportunities to enhance skills and experience by working with the new innovation of GSM, Modem and database thereby improving personal performance, which leads to better career advancement.

To the Organization it will help in the following areas:

- Improving the organization's performance through increased efficiency, productivity, quality and innovation.
- Ensuring corporate information availability just in time using mobile phone to authorized agents.
- Reducing the rate of fraud/crime associated with vehicle registration and ownership.
- May reduce training time for new employees

2. Review of Related Literature

GSM: short for **G***lobal* **S***ystem for* **M***obile Communications, is* one of the leading digital cellular systems. GSM uses narrowband TDMA, which allows eight simultaneous calls on the same radio frequency. GSM was first introduced in 1991. GSM technology usage began in earnest in Nigeria in August 2001, due to the deregulation of Telecommunication Industries.

2.1 History of GSM

In 1982, work began to develop a European standard for digital cellular voice telephony when the European Conference of Postal and Telecommunications Administrations (CEPT) created the Groupe Spécial Mobile committee and later provided a permanent technical support group based in Paris. Five years later, in 1987, 15 representatives from 13 European countries signed a memorandum of understanding in Copenhagen to develop and deploy a common cellular telephone system across Europe, and EU rules were passed to make GSM a mandatory standard.[1] The decision to develop a continental standard eventually resulted in a unified, open, standard-based network which was larger than that in the United States. In 1987 Europe produced the very first agreed GSM Technical Specification in February. Ministers from the four big EU countries cemented their political support for GSM with the Bonn Declaration on Global Information Networks in May and the GSM MoU was tabled for signature in September. The MoU drew-in mobile operators from across Europe to pledge to invest in new GSM networks to an ambitious common date. It got GSM up and running fast. In this short 37-week period the whole of Europe (countries and industries) had been brought behind GSM in a rare unity and speed guided by four public officials Armin Silberhorn (Germany), Stephen Temple (UK), Philippe Dupuis (France), and Renzo Failli (Italy). In 1989 the Groupe Spécial Mobile committee was transferred from CEPT to the European Telecommunications Standards Institute (ETSI). In parallel, France and Germany signed a joint development agreement in 1984 and were joined by Italy and the UK in 1986. In 1986 the European Commission proposed reserving the 900 MHz spectrum band for GSM. Phase I of the GSM specifications were published in 1990. The world's first GSM call was made by the former Finnish prime minister Harri Holkeri to Kaarina Suonio (mayor in city of Tampere) on July 1, 1991, on a network built by Telenokia and Siemens and operated by Radiolinja.[2] The following year 1992, the first short messaging service (SMS or "text message") message was sent and Vodafone UK and Telecom Finland signed the first international roaming agreement. Work began in 1991 to expand the GSM standard to the 1800 MHz frequency band and the first 1800 MHz network became operational in the UK by 1993. Also that year, Telecom Australia became the first network operator to deploy a GSM network outside Europe and the first practical hand-held GSM mobile phone became available. In 1995, fax, data and SMS messaging services were launched commercially, the first 1900 MHz GSM network became operational in the United States and GSM subscribers worldwide exceeded 10million. Also this year, the GSM Association was formed. Pre-paid GSM SIM cards were launched in 1996 and worldwide GSM subscribers passed 100 million in 1998.[3] In 2000, the first commercial GPRS services were launched and the first GPRS compatible handsets became available for sale. In 2001 the first UMTS (W-CDMA) network was launched and worldwide GSM subscribers exceeded 500

million. In 2002 the first Multimedia Messaging Service (MMS) was introduced and the first GSM network in the 800 MHz frequency band became operational. EDGE services first became operational in a network in 2003 and the number of worldwide GSM subscribers exceeded 1 billion in 2004[4]. By 2005, GSM networks accounted for more than 75% of the worldwide cellular network market, serving 1.5 billion subscribers. In 2005 the first HSDPA capable network also became operational. The first HSUPA network was launched in 2007 and worldwide GSM subscribers exceeded two billion in 2008.

The GSM Association estimates that technologies defined in the GSM standard serve 80% of the global mobile market, encompassing more than 5 billion people across more than 212 countries and territories, making GSM the most ubiquitous of the many standards for cellular networks.

Macau planned to phase out its GSM networks as of June 4, 2015, making it the first region to decommission a GSM network.

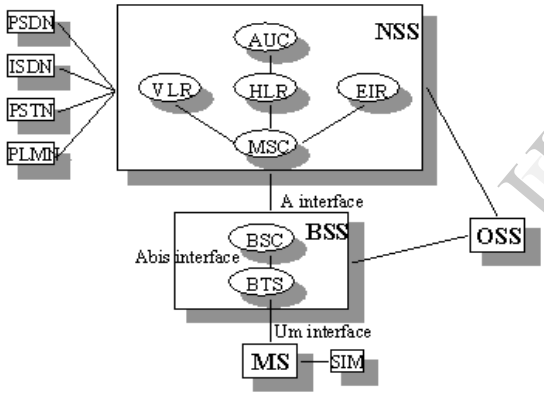

Fig 2: Architecture of the GSM network

The GSM network can be divided into four main parts (Fig 2):

- The Mobile Station (MS).
- The Base Station Subsystem (BSS).
- The Network and Switching Subsystem (NSS).
- The Operation and Support Subsystem (OSS).

1. Mobile Station: A Mobile Station consists of two main elements:

- **The Subscriber Identity Module (SIM)**: It is protected by a four-digit Personal Identification Number (PIN). In order to identify the subscriber to the system, the SIM card contains amongst others a unique International Mobile Subscriber Identity (IMSI). User mobility is provided through mapping the subscriber to the SIM card rather than the terminal as we done in past cellular systems.

- **Mobile equipment/terminal (ME):** There are different types of terminals (ME) distinguished principally by their power and application:
  - `fixed' terminals mainly installed in cars. Their maximum allowed output power is **20W.**
  - portable terminals can also be installed in vehicles. Their maximum allowed output power is **8W**.
  - handheld terminals; their popularity is owed to their weight and volume, which is continuously decreasing. According to some specification these terminals may emit up to **0.8W**. However, as technology has evolved their maximum allowed power output is limited to **0.1W**.

2. Base Station Subsystem: The BSS provides the interface between the ME and the NSS (Fig 2). It is in charge of the transmission and reception. It may be divided into two parts:

- **Base Station Controller (BSC):** It controls a group of Base Transceiver Station(BTSs) and manages their radio resources. A BSC is principally **in charge of handoffs**, frequency hopping, *exchange* functions and ***power control*** over each managed BTS.
- **Base Transceiver Station (BTS) or Base Station:** it maps to transceivers and antennas used in **each cell** of the network. It is usually placed in the centre of a cell. **Its transmitting power defines the size of a cell**. Each BTS has between 1-16 transceivers depending on the density of users in the cell.

3. NSS:[5] Its main role is to manage the communications between the mobile users and other users, such as mobile users, ISDN users, fixed telephony users, etc. It also includes data bases needed in order to store information about the subscribers and to manage their mobility. The

different components of the NSS are described below.

- **MSC:** the central component of the NSS. The MSC performs the switching functions of the network. It also provides connection to other networks.
- **GMSC:** A gateway that interconnects two networks: the **cellular network** and the **PSTN**. It is in charge of routing calls from the fixed network towards a GSM user. The GMSC is often implemented in the same machines as the MSC.
- **HLR:** The HLR stores information of the subscribers belonging to the coverage area of a MSC; it also stores the current location of these subscribers and the services to which they have access. The location of the subscriber maps to the **SS7** address of the Visitor Location Register (VLR) associated to the MN.
- **VLR:** contains information from a subscriber's HLR necessary to provide the subscribed services to visiting users(Fig 2). When a subscriber enters the covering area of a new MSC, the VLR associated to this MSC will request information about the new subscriber to its corresponding HLR. The VLR will then have enough data to assure the subscribed services without needing to ask the HLR each time a communication is established. The VLR is always implemented together with a MSC; thus, the area under control of the MSC is also the area under control of the VLR.
- **Authentication Centre (AuC):** It serves security purposes; it provides the parameters needed for authentication and encryption functions. These parameters allow verification of the subscriber's identity(Fig 2).
- **Equipment Identity Register (EIR):** EIR stores security-sensitive information about the mobile equipments. It maintains a list of all valid terminals as identified by their International Mobile Equipment Identity (IMEI). The EIR allows them to forbid calls from stolen or unauthorized terminals (e .g, a terminal which does not respect the specifications concerning the output RF power).
- **GSM Interworking Unit (GIWU):** The GIWU provides an interface to various networks for data communications. During these communications, the transmission of speech and data can be alternated.

4. Operation and Support Subsystem (OSS): It is connected to components of the NSS and the BSC, in order to **control and monitor** the GSM system (Fig 2). It is also in charge of controlling the **traffic load** of the BSS.[6] It must be noted that as the number of BS increases with the scaling of the subscriber population some of the maintenance tasks are transferred to the BTS, allowing savings in the cost of ownership of the system.

3 Methodology And System Analysis

3.1 Methodology

It has been defined also as follows:

1. The analysis of the principles of methods, rules, and postulates employed by a discipline.
2. The systematic study of methods that are, can be, or have been applied within a discipline.
3. The study or description of methods.

It is therefore, a set of methods by which one can follow to arrive at a certain solution, they are:

a. Structured Analysis and Design methods: These are methods for analyzing and converting business requirements into specifications and ultimately, computer programs and related manual procedures. Structured analysis and design techniques are fundamental tools of systems analysis. The analysis consists of interpreting the system concept into data and control terminology, that is into data flow diagrams.

b. SSADM: Structured Systems Analysis and Design Method (SSADM) is the method which is used at projecting and analysis of information systems. SSADM divides an application development project into modules, stages steps and takes and provide a framework for describing projects in a fashion suited to managing the project. SSADM's objectives are to:

- Improve project management
- Make more effective use of experienced and inexperienced development staff.
- Develop better quality systems.
- Make projects resilient to the loss of staff.
- Enable projects to be supported by computer -based tools such as computer aided software engineering systems.
- Establish a framework for good communication between participants in a project.

c. Object-oriented analysis and design: Object-oriented analysis (OOA) is the process of analyzing a task (also known as a problem domain), to develop a conceptual model that can then be used to complete

the task. (OOAD) is a software engineering approach that models a system as a group of interacting objects. Each object represents some entity of interest in the system being modeled, and is characterized by its class, its state (data elements), and its behavior.

d. Prototyping

Prototyping, as a methodology is important in building fast, better, more reliable, better quality systems. Prototyping is based on building a model of a system to be developed. Moreover, the initial model should include the major program modules, the database, screens, reports, and the inputs and outputs that the system will use for communicating with other (interfacing) systems.

Choice Design Approach

SSADM is the choice of design approach used for the project because it deals with the easiest way to develop a system, and at the same time document them.

3.2 Analysis of the Present System

Vehicle Registration and inspection in Nigeria began over 70 years ago and records have been essentially manual which in turn has not help to raise the efficiency of general automotive services in recent years. This involves manual recording of vehicle's information which ranges from cars, buses, trucks and heavy duty equipment on ledgers stored in files. Normally when an information a vehicle is needed, sourcing for the file in a long drawers of files is difficult and wastes time, sometimes most of the records will be lost. There is delay associated with the registration, because of the manual methods of operation, The issue of security of records is serious because of lack of proper and accurate keeping of information about old records that have been stored for some time. The Vehicle inspection office has no new system rather than, when one buys a new car from Nigeria or abroad, it is taken to their office for verification and registration, after which a form will be given to the car owner to fill up and these comprises of the following information: registration details, road worthiness test certificates, change of ownership, engine and chassis numbers, and expiration of road license, after which all these will be stored in a file cabinet. Imagine that 500 cars are registered in Nigeria in a month with all the forms and papers filled, the documents will be of great size, dirty and files and folders will be difficult to locate. Presently, the mode of storage is in bare paper forms and in some cases in computer form like the diskette, leading to lack of proper database maintenance plan and database recovery plan etc.

3.3 The Proposed System

The Proposed System which is GSM Vehicle Inspection and Verification System, is a System that will help to overcome the problems of the present system. It is a means by which an authorized agent accesses the Company's database to view information about any type of vehicle anytime, anywhere, even in remote areas that has a GSM network coverage. The data or code which can be used to view the Vehicles particulars could be the chassis number or the engine number, this is a number that no two vehicles can have. With this new system, the company will be able to achieve the following:

- Have an easy and fast way to detect unauthorized vehicle users.
- Enhance effectiveness and efficiency in the work by avoiding the use of papers and files.
- There will be consistency and enhanced security of data
- Easy access to data in terms of update, retrieval and accessing of one's record.

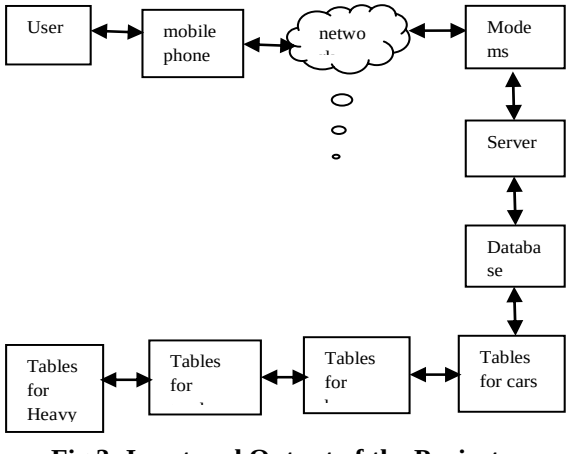

Fig 3: Input and Output of the Project

Fig 3 depicts the way the project works but in a block form. First the user uses his/her phone to send his query, it passes through a GSM network to the Modem that receives the query, the AT Command interprets it to the Server, a program written in VB.NET fetches the response from the required table.

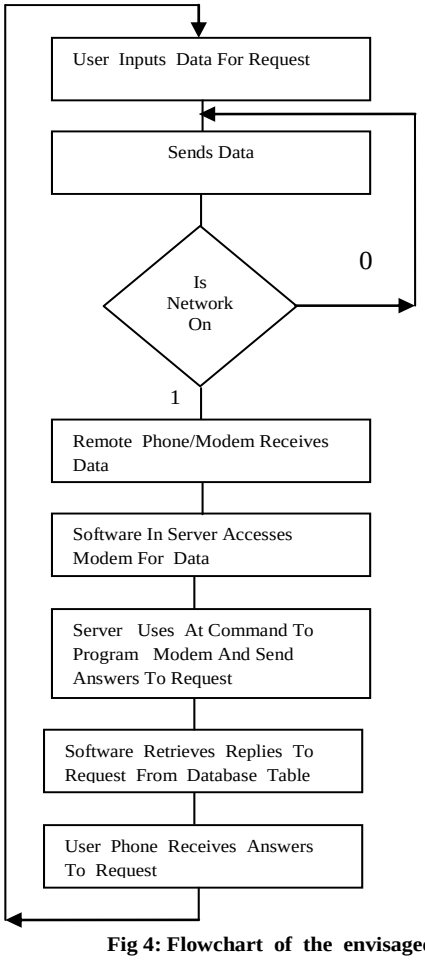

Fig 4: Flowchart of the envisaged System

Flowchart of the envisaged system (Fig 4) visions that a user inputs data in the mobile phone, sends the data by clicking on the send button, the data travels through a GSM network if the network service is OK else it returns back to the previous stage(Sends data). The modem receives the data, through the help of the AT Commands is able to interpret it to the Server. A software in Server pulls out the right answer from the database. The process repeats again if there is still another operation.

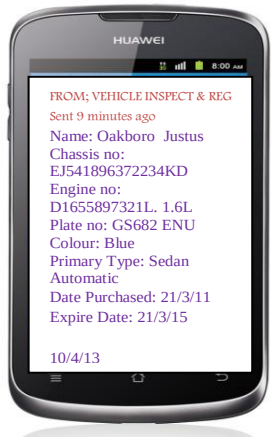

Fig 5: Phone Picture of the Project.

Fig 5 is a Phone view of the project, where all the data of a vehicle owned by Oakboro Justus is been viewed.

Conclusion

The revolution of information and communication technology (ICT) has brought assurance to many people especially low income earners that they can feed themselves or families, provide shelter for selves and have a secured future. The Global Service for Mobile communication (GSM) serves as a tool for economic, political and social interactions among people of all professions, classes and status. The GSM is said to have improved the capacity of most people that rely on it as an important means of communication needed to be able to do their jobs. The GSM usage has also helped to bridge the access gap for students and lecturers as in the case of result checking, looking for books in the library etc. The importance of GSM is so great that it will not just help in doing work easily but effectively and efficiently and if properly maintained in the country will also improve its economy. But an appropriate software and a database accessible on line are very essential as described in the forgoing.

References

[1] Michel Mouly and Marie-Bernadette Pautet: GSM System for Mobile Communications, published by the authors 1992,

[2] Friedhelm Hillebrand (editor): GSM and UMTS, the creation of Global Mobile Communication, Wiley 2001

[3] Jan A. Audestad Network aspects of the GSM system. In EUROCON 88, June 1988

[4] David Cheeseman. The pan-European cellular mobile radio system. In R.C.V. Macario, editor, Personal and Mobile Radio Systems. Peter Peregrinus, London, 1991.

[5] I. Harris. Data in the GSM cellular network. In D. M. Balston and R.C.V. Macario, editors, Cellular Radio Systems. Artech House, Boston, 1993.

[6]Michel Mouly and Marie-Bernadette Pautet. The GSM System for Mobile Communications. Published by the authors, 1992.