Vehicle Accident Alert and Locator (VAAL)

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***Abstract*- An emergency is a deviation from planned or expected behaviour or a course of event that endangers or adversely affects people, property, or the environment. This paper reports a complete research work in accident (automobile) emergency alert situation. The authors were able to programme a GPS / GSM module incorporating a crash detector to report automatically via the GSM communication platform (using SMS messaging) to the *nearest* agencies such as police posts, hospitals, fire services etc, giving the exact position of the point where the crash had occurred. This will allow early response and rescue of accident victims; saving lives and properties. The paper reports its experimental results, gives appropriate conclusions and recommendations.**

***Index Term*-- Accident Alert, Crash Detector, Emergency, Location Based Services, GPS/ GSM, VAAL.**

I. INTRODUCTION

When an auto crash occurs suddenly, the reaction of the emergency services now becomes a race between life and death. Today, wireless innovation has tilted the odds in favor of success like never before. Before, the people in the emergency services had little more to rely upon than raw courage. Now the world of wireless has inspired an entirely new way of managing and minimizing the death rate due to auto crash.

The scene of a fatal accident is always a theater where man and technology face the ultimate test. Whether the emergency is fire, earthquake or flood, relief or needed medical attention in this case, the stakes are always high. Indeed, wireless communications has become extremely important in emergency response. Obviously the most important tool in any situation is people. But better information with the aid of machine-to-machine (M2M) network means better decision making and that means technology is helping to save property and lives.

Accident Alert System (AAS) is quite a novel research area, on the 15th of January, 2007, the European Commission (EC) proposed an auto crash alert system called the e-call. The e-call system is intended to automatically initiate an emergency call to 112 from the vehicle and transmits satellite positioning data to the operator in case of a road accident. It has been estimated by a new research report from the analyst firm; Berg Insight that e-call could save thousands of live and that it's long term saving would be in the range of €5-10 billion, whereas the long term cost is projected at €4 billion[1],[9].

Vehicle tracking systems have been deployed by private companies to clients that desire such services across the globe and it's recent surge in Africa and most especially in Nigeria is not a news[2],[7],[10],[8]. However, Emergency Alert System (EAS) is a novel research and development area even in advanced countries [2],[3],[5],[11]. Some experiences of the development in this interesting life saving research area are illustrated as follows:

There are variants of location based systems with various advantages and disadvantages.

E-OTD [4] uses a mobile signal from base-station to call special chip and then to fixed location known to operators. This is triangulated among three points, it has an accuracy of 5 to 50m but it involves high network investment cost for the operator and also requires new handset.

GPS method uses satellite sent positioning signal to handsets equipped with GPS chip, which calculates it's own location to approximately 1-10m. It has a high accuracy but could be used only outdoor.

Another good example of emergency alert system is the Trako System from India[6], It uses the GPS coupled with geo-referenced GIS (Geographical Information System) maps to communicate real-time information to the control station. A handset provided allows the driver to speak to the control station anytime and send an alert in case of emergency through the hotline buttons provided on it. The trip reports and maps generated by the system can also be conveniently viewed through a web interface.

However, the approach adopted for our research work on VAAL uses the GPS for position detection and the GSM or CDMA platform for onward transmission of the pinpointed position to the nearest federal or state rescue agencies. We adopted the use of SMS messaging because in the third world (Nigeria in particular), the attention being paid to emergency calls is grossly inadequate and this has wrecked a lot of havocs on lives and properties.

II. MATERIALS AND METHODS

In this research work, we made use of M2M technologies and GPS/GSM module which is a device that operates mostly under M2M platform. M2M simply involves devices that can communicate over a network without human interference. Telit GM862-GPS wireless system is the main choice for the automobile GPS/GSM module used[12].

A. VAAL Architecture and Signal Flow

The VAAL platform is as shown(in fig. 1). A particular country is divided into areas and the areas are sub-divided into sectors, in every sector, there are police stations. If an automobile crash occurs in a particular sector, the information flow is shown as labeled numerically in the diagram. The

GPS/GSM module works with an installed crash detector. This module is constantly being tracked by the GPS satellite constellations in the orbit. These satellites make it possible for ground GPS receivers installed in a vehicle to pinpoint the geographical location and obtain the exact latitude, longitude, speed , altitude and time of crash of the vehicle, with location accuracy ranging from 1-10 meters (signal 1).

In case of automobile crash, the crash detector sends an activating signal to the GPS/GSM module, this module is programmed to fetch from the memory, personalized plate number of the

particular vehicle involved; coupled with the GPS information (i.e. latitude, longitude, speed etc) An SMS message is sent to a communication database server (CDS) (signals 2,3) . The CDS automatically compares the information received (plate number in this case) with the mapped information in the memory.

The communication database server fetches the above information alongside the GPS data received(signal 4) and send them to the appropriate agencies such as nearest FRSC, Police Station, Medical Centers etc (signal 5) for immediate deployment of paramedic officials as well as all emergency units within the vicinity of the crash.

The road officials could communicate with the vehicle (signal 6) to find out the exact physical situation of the event, if there are persons in the vehicle to respond accurately to these questions, (signal 7), the paramedic with the FRSC informs the nearest hospital or medical centers of the extent of medical attention needed by the victims(signal 8). All information from sectoral database are sent to a centralized database for backup(signal 9).

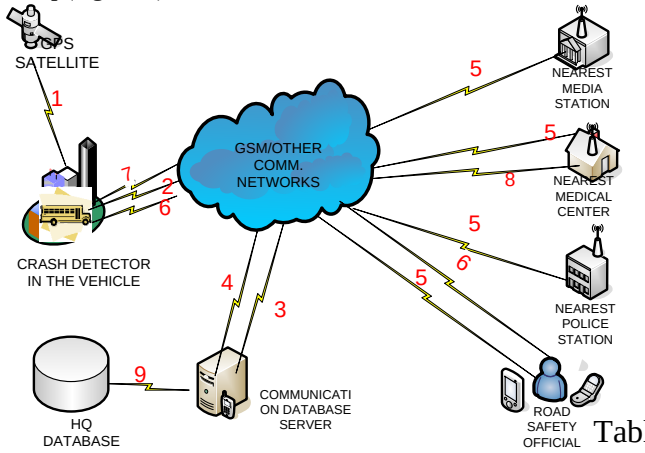

Fig. 1. VAAL Architecture

Table 1.

Also, for an unlawfully taken vehicle, the police could query the location of the vehicle at will through an SMS message and get a precise point where it is located or line of movement for it to be intercepted.

B. VAAL Experimental Setup

VAAL was tested by setting up a Metropolitan Area Network (MAN) to simulate an automobile crash(fig. 2). The MAN is comprised of a model vehicle, a communication database server (CDS) and the recipients (i.e. Police, Hospitals etc).

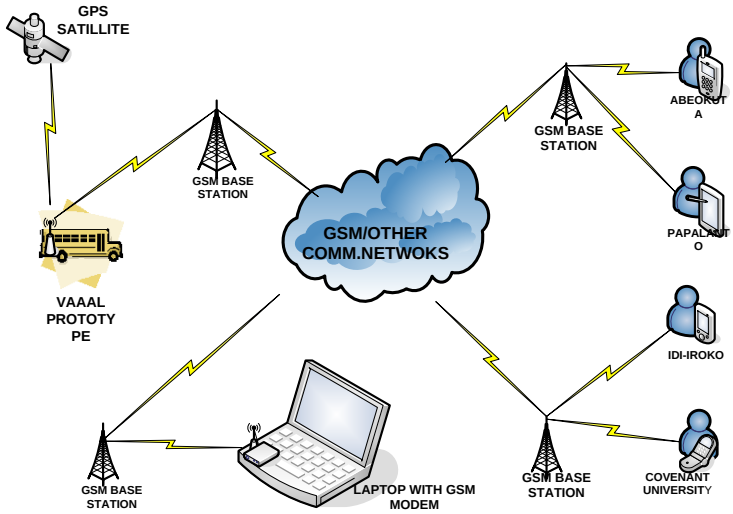

Fig. 2. VAAL Experimental Set-Up

A GPS/GSM module as well as the crash detector was installed in the vehicle. The CDS is a laptop incorporating a GSM modem and running an SMS Messaging Server. We represented the various organizations or agencies involved with different persons scattered across a geographical area (around Ogun state in Nigeria). One recipient was in Abeokuta, another in Papalanto (a suburb of Ota town), another recipient was located at Idi-Iroko (a border town which is a few kilometers from Canaanland where Covenant University is located. Various locations in Covenant University were mapped using a GPS receiver (see Table I,bellow).

III. RESULT

Table I
Geographical Map of Selected Points on Canaanland, Ota, Nigeria.

S/N	LOCATIONS	LONGITUDES	LATITUDES
1	Chapel-Front	3.15561	6.66987
2	Library-Bus Stop	3.15510	6.67000
3	Library - Esther hall side	3.15437	6.67000
4	Library –Back	3.15423	6.67100
5	Dorcas – Deborah	3.15421	6.67160
6	Dorcas- Front	3.15440	6.67231
7	Dorcas – Generator plant	3.15437	6.67273
8	Deborah –Front	3.15320	6.67148
9	Lydia – Front	3.15308	6.67200
10	Mary – Front	3.15278	6.67203

The model vehicle which has the crash detector installed in it was placed in another moving vehicle within the premises of the university. A switch which operates like an automobile air bag activator is pressed to simulate a crash when the real vehicle was in motion. Because of the synchronized movement of both vehicles; the GPS receiver assumed the motion of the real vehicle as that of the model and positive results were generated. A typical information received at various testing sites is as follows:

"A RED SALOON CAR WITH PLATE NO: 23338 CRASHED AT LONG. 3.15561 LAT. 6.66987 MOVING AT 80Km/hr, BELONGING TO DR. VICTOR JOHN AT 15:17, 182m geoids on 17th of July, 2007 PLEASE URGENT RESPONSE IS NEEDED."

From the digital map with the recipient(Table 1), it could be inferred that the precise point of the accident is at the front of the chapel in Covenant University and urgent attention should be taken.

It was observed that the SMS messages got to the recipients in various locations between 1- 15 seconds. It was also observed that the delivery of the SMS messages could be network dependent. To address the delay in delivery of the SMS by the network, we are already having discussion with Nigerian GSM operators for dedicated bandwidth. This will greatly enhance the reliability of the platform for tackling emergency situations. The various pictures taken while VAAL prototype was being built in the workshop are shown in figure 3.

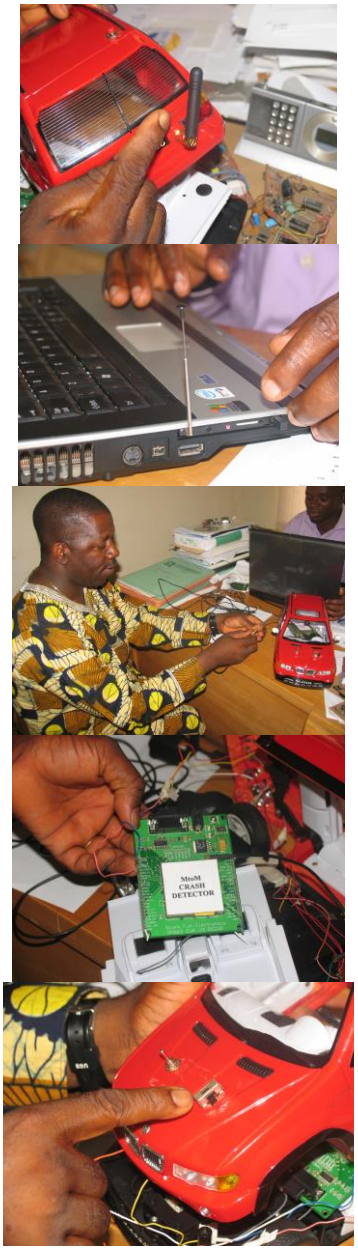

Fig. 3. Production of VAAL prototype in the workshop.

IV. CONCLUSION

In order to develop VAAL, three main players were identified i.e. the automobile incorporating a machine-to-machine (M2M) device (GPS/GSM modem with a crash detector), the mobile operator and the emergency organizations, where all players are joined together by the geographic information network.

In this research work, we have designed a platform for emergency rescue in case of an auto crash and developed a prototype and tested it. We actually identified the possible technical gaps and dealt with them. Therefore, the platform operates optimally in order to reduce the golden time of arrival when every micro-second counts.

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