

The Challenges, Services and Real -Time Capabilities of Mobile and Web GIS for Emergency Management in Nigeria

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SUMMARY

The advent of the Mobile and Web GIS are great milestone in the evolution of civilization. Everything that happens somewhere, knowing "what" is "where" and "why" it is there can be actually critically important for making decisions, action plans and development. Geographic Information System (GIS) is the technology as well as the science for handling the "where" type of questions. This paper presents a framework of how Mobile and Web GIS have become embedded in many Location Based Services (LBS) applications, particularly in navigation functions and location awareness. Mobile and web GIS have taken advantage of technologies (wireless network, mobile devices, and Smartphone) to offer the possibility of exchanging and analyzing Spatial Information in real geographic world time. The challenges involved include the scarce resource of mobile devices in respect with memory size, network limitation, computing power, communication bandwidth and accessing multiple heterogeneous data sources. The utilization of Mobile and Web GIS systems enables effective practice of emergency management of any possible disaster events whereby giving personnel information to plan, implement, modify and respond in real time world operations by simply providing a rich set of data management, visualization, analysis capabilities and Spatial Service Sharing. Finally status of emergency management in Nigeria and the prospects of application of Mobile GIS are presented and discussed.

1.0 INTRODUCTION

Globally, the use of mobile and web based GIS system have become more popular and widespread in different spheres of human live. As a result of the recent improvement in technology, people can now make use of the internet from almost anywhere, anytime and at will. This improvement is made feasible due to the advancement in wireless facilities, mobile computers and some applications (Nyamugama et al., 2007). This unique technology makes information to be readily available at the appropriate time and accessible regardless of the location of the user. The use of these applications in emergency management will go a long way in providing information for planning and implementing rescue operation in emergency situations. During emergency such as suicide bombing that often claim several of lives, the use of mobile and web based GIS system will help in rescue operation as the system will provide accurate information on the incident location which enables rescue operations to be carried out efficiently and easily (Nyamugama et al., 2007). As a result of the complex nature of environmental structure, emergency situations worldwide have become a serious phenomenon that threatens human life and property. As a result of this, appropriate management of emergency situations is a current phenomenon in the present time.

2.0 EMERGENCY MANAGEMENT PROCESS

The process of emergency management has several phases beginning from planning to mitigation and preparedness (as pre-emergency phase) and response and recovery (as during and post-emergency phases). However, in each of these phases, emergency management requires accurate and dependable information about the current situation of emergency, existing sources and facilities (Mobaraki et al., 2007). Emergency management or disaster management deals directly with loss of human life and property damage. The tragic event of Hurricane Katrina in the US in September 2005 showed how significant disaster management is. The implementation of disaster management systems can save thousands of lives, but when it poorly implemented it can cause considerable casualties, damage and loss in various dimensions when the disaster actually happens.

In the management and reduction of disasters, knowledge of the environment is provided by geoinformation and space technology tools. The main components of these tools are: up-to-date topographical maps, remote sensing, GIS database, appropriate Spatial Data Infrastructure (SDI), early warning systems through international cooperation, as well as Mobile and Web GIS. In order to create a comprehensive disaster management system, government and agencies concerned in its implementation need to rely on advanced geospatial technologies and services. Indeed, in the present era, mobile GIS are essential technologies for the future development of disaster management systems.

2.1 MOBILE AND WEB GIS SYSTEM

Mobile and web based GIS system are integrated software and hardware frameworks for easy access of geospatial data and services through mobile devices via wireless networks (Tsou, 2004). These applications can combine GPS and satellite images to assist the National Emergency Management Authority and emergency response teams in identifying potential threat areas. Through this approach, critical "hot zones" can be created for emergency response. Near real-time spatial analysis models supported by GIS could be used to rapidly generate the most effective evacuation routes and emergency plans during natural hazard events, including wildfires, floods and tsunamis (Tsou & Sun, 2006). With the mobile and web GIS technology, emergency workers, inspectors, maintenance teams, utility crews, fire fighters, and many other field workers now have the potential to access the enterprise geospatial data at the server-side to accomplish their tasks with high level of accuracy. More importantly, updating these geospatial enterprises is feasible (EL-Gamily et al., 2010).

3.0 Mobile and Web GIS Services for Emergency Response and Disaster Recovery

Mobile and web GIS is a movable system which makes it possible and timely for spatial data acquisition, storage, sharing and analysis everywhere possible for users. In mobile GIS, data, hardware and software are movable for quick emergency response. This unique characteristic makes mobile and web GIS an efficient technology in handling and managing spatial data (geographically referenced features) mostly during the time for emergency management. In disaster management, emergency response is the most critical phase because it enables informed decision to be carried out at when due. Mobile and web GIS services can play a very vital role in evacuation, dispatch and vehicle tracking. In order to activate an evacuation plan, emergency managers or planner as well as concerned agencies saddled with such responsibility would as a matter of necessity have to put gather the most simplified and updated geospatial information from the field as quickly as possible. According to Mobaraki et al., (2007), Mobile GIS has two fundamental applications in emergency management, the applications include:

- It makes it possible for the collection of infield data and real time updating of Emergency Operation Centre (EOC) database. The data collected gives precise information about site of bomb blast, location of victims, burning buildings, closed routes, accidents, etc.
- The use of mobile and web GIS makes it easy for emergency workers to access EOC database which gives information on the present status of emergency situation. Mobile GIS also provides the capability of analyzing these data to make the best infield decisions for

emergency operations. However, two examples of this analysis are: looking for the best path to get into specific destinations and priorities emergency operations based on current situation of emergency response.

By putting together mobile and web GIS software, wireless communications and GPS can be translated to emergency response agents, and the information passed will enable them to report the ground truth immediately via cellular networks. For instance, if a group of army fighting the ongoing insurgency in the Northeast in Nigeria happens to find a possible terrorist attack target, they can immediately submit the hot zone and publish the information to every soldier in the nearby area for quick response. Mobile and web GIS platforms make it easy and timely for critical information to be constantly updated more effectively and efficiently than traditional radio signal conversions and report mechanisms (Tsou & Sun, 2006). In addition to real time GIS updates and dispatches, another essential task in emergency response is that these devices can also be used to track all in-field agents. Which if properly used can reduce the number of casualties to in-field emergency response agents. Furthermore, Tsou & Sun (2006) alleged that mobile and web GIS can be applied in both long-term and short-term recovery tasks. Long-term recovery tasks include re-building damaged houses, ecological conservation and restoration and community reconstruction which require years of efforts to recover the damages caused by disasters. Mobile and web GIS can assist in some tasks like the detection of land use change in environmental remediation. Whereas, for short-term recovery tasks, the main focal point is to restore vital life-support systems to bare minimum operating conditions. Rehabilitating damaged roads and bridges and electrical poles among others are some of the short-term recovery tasks. Mobile and web GIS applications can help the emergency managers to achieve these long-term and short-term recovery tasks via the utilization of utility mapping combined with GPS to identify the extent of damages in specific areas (Tsou & Sun, 2006).

3.1 EMERGENCY MANAGEMENT IN NIGERIA

A quick survey of the Nigerian environment reveals that the administrative, technical and technological expertise required for sustainable emergency management and reduction are grossly inadequate and, where they exist, dismally uncoordinated.

The prospect for emergency response, disaster reduction and management is very poor as the basic infrastructure are lacking: topographical maps are tragically obsolete, funding of geoinformation production is dismally low, there are no policy direction for geodata production; the National Spatial Data Infrastructure (NSDI) is still on paper; while the UN's recommendation on reduction and management of disasters in the last three decades are largely not domesticated

in practical terms (Atilola, 2005). There are no adequate geodata infrastructure for holistic emergency and disaster management. The national organisation responsible for disaster management, NEMA, with its States counterpart is mainly engaged in the recovery component of disaster management with low emergency response capability. Without a national GIS database and a functional NSDI the nation cannot implement the international recommendations on disaster management, a prerequisite for benefiting from global initiative on geodata sharing for disaster management activities; neither can the capability for adequate response to emergency be developed (Atilola, 2005). The lack of basic adequate database and access to international data sharing, as well as the hiatus in the communication and energy sectors constitute major obstacle to deployment of mobile and web GIS in the country.

4.0 CHALLENGES OF MOBILE AND WEB G.I.S FOR EMERGENCY MANAGEMENT IN NIGERIA

Irrespective of the massive role mobile and web GIS play in emergency management, these devices are not well utilized in Nigeria which makes it impossible for emergency response agents like fire fighters to respond quickly to disasters when they occur, such as fire outbreak in residential and market areas. The country is yet to reap the importance of these recent technologies in handling and managing her emergency situations. As a result of the poor installation or absence of web and GIS technologies, often times, response action is initiated when it is late and severe damage is recorded. Some of the factors that have hindered the successful implementation and use of mobile and web GIS devices for the adequate management of emergency situations in Nigeria include scarce resource of mobile devices in respect to memory size, network limitation, computing power, communication bandwidth and accessing multiple heterogeneous data sources using different transmission mechanism making it difficult and obstructing many desirable use by mobile/ web clients to effectively make use of Geospatial Web Services. Constant network failure is one of the impediments to the use of mobile and web GIS in emergency management. To effectively and efficiently use these devices and platforms, network need to be stable and excellent to enable the updating and transmission of real-time data, this will enable informed decisions to be taken depending on the existing situation. But in Nigeria, the services of the various network providers cannot be relied upon due to their limitations mostly when they are most needed. This situation will affect the ability of emergency workers to access EOC database to get information on the present status of emergency situation. Since network signals in Nigeria deteriorate daily, it affects the computing power of these devices to acquire spatial data, store it and share the information for rapid action.

5.0 RECOMMENDATIONS

For the country to benefit from Mobile and Web GIS technology, GIS database must be created, National Geospatial Data Infrastructure which has been on the drawing board since 2004 must be speedily implemented; the UN's recommendations on disaster management and reduction should be domesticated to establish international collaborative disaster management programme that will enable her access the international space initiatives on Space Technology for Disaster Reduction and Management. This will enhance the deployment of Mobile and Web GIS.

The National Emergency Management Authority, NEMA, must be overhauled. There must be aggressive capacity building, and establishment of technological transfer programme. The organization must also be technically empowered by provision of geodata infrastructure driven by Mobile and Web GIS. An Emergency Operation Centre (EOC) database which can be incorporated into the proposed NGDI and accessed by Mobile GIS system should be created. There must be appropriate training in the use of the geospatial datasets. As part of its capacity building, emergency reduction and management programmes must be established at both local and state government levels. All relevant disaster management agencies such as the ambulance, Red Cross, Police, Fire-brigade, health and civil rescue personnel must be properly coordinated, equipped with mobile GIS and have access to Emergency Operation Centre (EOC) database; and also be involved in the disaster reduction and management planning programmes. NEMA should develop a National Disaster, Hazard and Vulnerability Atlas for disaster management using Web-enabled GIS as the primary interface. The Virtual Atlas should support all the phases of disaster reduction and management process.

6.0 CONCLUSION

This paper has been able to highlight some of the vital roles mobile and web GIS play in emergency management. Due to the high degree of mobility of these devices, mobile and web GIS makes it possible for emergency workers to have potential access to geospatial data on time which enables them to accomplish their tasks with high level of accuracy. The design of mobile GIS platform enables users (emergency workers) to view infield information regardless of the location. But in Nigeria, these devices have not been fully exploited to enable emergency workers handle and adequately manage emergency situations or disasters. This makes rescue action most times to be in futility as a result of the damage which is recorded before the arrival of rescue action or emergency response team. Government is therefore encouraged to invest heavily on this recent mobile technology to enable it protects lives and properties as well as tackle any form of environmental and social issue like the problem of insurgency and constant

fire outburst and road accidents. This is because if these devices are installed and manned by well trained personnel critical "hot zones" can be created for emergency response. Network providers in the country should try to make their networks excellent for the smooth transmission of information necessary for rescue operation.

References

- EL-Gamily, I.H., Selim, G. & Hermas, E.A. (2010) Wireless mobile field-based GIS science and technology for crisis management process: A case study of a fire event, Cairo, Egypt. *The Egyptian Journal of Remote Sensing and Space Sciences*, 13, 21-29
- Mobaraki, A., Mansourian, A., Malek, M. & Mohammadi, H. (2007) Application of mobile GIS and SDI for emergency management. Available at: <http://www.isprs.org/proceedings/XXXVI/part1/Papers/PS3-50.pdf>
- Nyamugama, A., Kanda, A., Masaraneyi, F.S & Gombiro, C. (2007) The application of mobile GIS in disaster notification information management system. *Journal of Sustainable Development in Africa*, 9 (2): 15 - 25.
- Tsou, M. & Sun, C. (2006) Chapter 12: Mobile GIServices applied to disaster management. Available at: http://geography.sdsu.edu/People/Pages/tsou/papers/2007-Innovations-GIS-Section%204_Chapter%2012_Tsou_vfinal.pdf

Biographical notes

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