Review of Accident Information Systems in Web Domain

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Abstract—This paper presents a review of real time information system related to accidents, traffic, obstacles etc. over the web using GIS (Geographic Information System). Reviewed papers include accident datasets, methodologies with tools and many significant features of web application to extract spatial and attribute information using Web based GIS. Accident datasets contains detailed about accidents (fatality, severity, injury etc.) with accident types and high rate accident locations, environment variables, temporal data, road conditions, emergency, safety information and so on. Methodologies generally describe requirement analysis, hardware and software survey, database design and web based GIS or WebGIS development. It also includes study area and tools with description. Tools basically defines all hardware and software tools which enables three tier architecture of Web based GIS system which can be defined on the basis of layers defining application layer as client architecture, service layer as middle architecture and database architecture. Suitable preventive measures regarding the improvement of traffic, road, and safety conditions are also suggested for minimizing accident rate. Proposed idea is to provide an efficient Accident Information System with high accuracy or performance with the use of Python scripting language on the server side with time saving geospatial calculation, analysis and reporting.

Keywords—GIS, Traffic and Accident information, Accident datasets, PostgreSQL/PostGIS, Open Layers, WebGIS and Web services.

1. INTRODUCTION

A lot of efforts have been earlier done on web based information system in case of road accidents, traffic information, management, analysis and reporting etc. with the development of Information Technology and GIS. GIS is a growing Technology for managing and processing position related information with visual ability of sophisticated analysis and quick decision. GIS provides a platform for connection between diverse streams of and analysis and various output functions.

Web based GIS or WebGIS is a part of Internet GIS which enables accessible of geographic or non geographic data over the web via communication protocol e.g. WWW (World Wide Web). Efforts by IOWA department of transportation enable the development of GIS-ALAS i.e. GIS based Accident Location and Analysis System on the basis of PC-ALAS desktop based ALAS but in graphical environment. It enables the user accessible in case of visualization and selecting desired location over the network with the high operating speed and effective integration (Pawlovich and Reginald, 1996). A traffic control system and an algorithm for optimal path routing have been developed to inform drivers about the optimal route on the basis of high/low traffic volume road width, accidents, Snow and flooding and dynamic changes of road density (Hassan and Malik, 2005). A literature review on GIS based multicriteria decision analysis between 1990 and 2004 enables to understand both transform and combine process of geospatial data simultaneously (Malczewski, 2006). Proper analysis of spatial and temporal pattern, easily retrieving information, fast communication and fast response system can only reduce the probability of accident occurrence. Introducing GIS i.e. Geographic Information System provides many benefits in the area of visualization of accident data and hot spots analysis (Erdogan et al., 2008). Increasing road accidents everyday affects the development of many sectors. Approximately 85,000 persons and 300,000 persons in India are recorded to be killed and injured respectively on the road accidents (Mohan, 2009). Emergency management system is a big challenge in case of accidents. Based on advanced technologies e.g. web services & service oriented architecture, a distributed emergency management system provides a tool for easy and fast access spatial related data for management and communication purpose e.g. emergency vehicle routing (Li et al., 2009). Real
time updating of geospatial data and attribute information provides benefits for traffic safety issues (Shengwu, 2010). A framework for spatial clustering based real time traffic accident risk mapping have been developed for determining many factors in different direction e.g. accident concentration areas, weather conditions etc. (Wang and Wang, 2011). Real-time Web application for traffic information has been developed using Geographic Information System to achieve an optimal vehicle routing (Alazab et al., 2011). For travel information according to the needs of users, A WebGIS based public traffic information system analysis has been performed to provides services e.g. query service, real-time traffic services, travel planning services etc. (Pei and Jiao, 2011). A traffic accident management system with high efficiency and query capability from heterogeneous sources in an efficient way is an important factor to reduce traffic accidents (Fouz and Afandi, 2012). A complete understanding of Traffic Accident Reporting System is done through UML (unified modelling language) using GIS in order to solve the problem of maintenance of accident data and report (Ansari and Al-shabi, 2012). Traffic congestion can be defined in terms of slower speeds, longer trip times and increased vehicular queuing. Efficiency and effectiveness of traffic congestion counter measures in Coimbatore has been improved using Geographic Information System based model by enabling sophisticated and quick decision making (Anitha et al., 2013). WebGIS based depth analysis of black spots of frequently occurring accidents is carried out in order to identify the high danger rate, high density areas and extract important information with less time compared to previous web based analysis on the basis of query on those areas (Vigneswari and Minachi, 2013). An open source Web-based GIS Software has been introduced to reduce the development or maintenance cost by purposing an effective road management system in order to maintain and manage road conditions over the web (Yusoff et al., 2014a). Open source refers to collaborative effort which provides easy universal access via free licence and easily available source code for modification and improvement. Road management system is a factor to reduce the accidents and play a very important role in accident information system by using shortest path routing or ambulance routing in case of accidents. A real time routing system has been provided to avoid obstacles on the road via shortest path analysis (Yusoff et al., 2014b). This system provides many benefits for all public users by selecting the route of travel to avoid traffic problems. A feasible, robust and reliable traffic prediction system makes advanced traffic management system and advanced traveller information system more efficient. To improve the traffic management system in Beijing, a real time traffic prediction system has been developed in order to provide the accurate and timely prediction of accidents (Li et al., 2014). A national information system on traffic accidents report and Medical report of injuries in Swedish road transport named STRADA (Swedish Traffic Accident Data Acquisition) has been reviewed for gaining access through web based client on the injury related analysis (Howard and Linder, 2014).

II. METHODOLOGIES ADOPTED BY VARIOUS RESEARCHERS

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<th>Methodological Steps</th>
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<th>Short Description of Tools</th>
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• Accident, traffic & road geometry related data and calculate safety level, specific spot collection.
• Spatial data managed by spatial database server MS SQL server 2000.
• A communication is established by spatial data engine ArcSDE 9.0 between spatial DBMS and any other GIS related request.
• Internet Map server ArcIMS 9.0 works in two parts i.e. Spatial for execute client’s request and Application for distribute request to spatial.
• A communication link is established between web server and IMS by Connectors i.e. ArcIMS Servlet Connector, Java Connector.
• Web server i.e. Apache HTTP Server 2.0.48 and Custom Applications i.e. Java Developer Kit 1.5.0 is established.

Pei and Jiao, 2011 [12]

• WebGIS Development using common Gateway Interface (CGI), Plug-in technology, Server API (Application Programming Interface), ActiveX and Java Applet technology.
• System design using structured standard language e.g. XML (extensible mark-up language) or XHTML (extensible Hypertext mark-up language) with graphic design and HTML coding.
• Provides functions e.g. Real time Traffic, Electronic map, Public transportation, Bus transfer services and query about public transportation and around area.

Yusoff et.al. 2014a [17]

• Software and Hardware requirement analysis.
• Finding and acquiring routable data from OSM (OpenStreetMap).
• Modify database attribute table i.e. convert OSM format into SQL format.
• Develop Application using PHP and Apache web server.
• Loading Obstacles into database.
• Analysis of shortest path with and without obstacles.
• Comparing results on OSM.

Yusoff et.al., 2014b [18]

• Universiti Putra Malaysia GIS, WebGIS.
• WebGIS: Client side GIS web application using
III. PYTHON BASED ARCHITECTURE & IMPLEMENTATION

From the previous literature review, five phases are required for WebGIS development. First of all, Requirement analysis is required which provides all the information of traffic, vehicle, environment, driver etc. Hardware and software analysis and requirement is also needed. A high performance software is needed for the web based information system. After that database is required which enables spatial database management system. Database platform is needed to manipulating; retrieve all information by queries to the user through the web browsers. For spatial database management system, PostgreSQL/PostGIS are essential to store all the point, lines and polygon information contain in accident datasets. The accident dataset contains the detailed information about accidents like accident severity (fatal, non-fatal etc), accident location (region, district, county, road number, road segment, distance from the start of road segments, address etc), high rate accident location, safety deficient areas and the accidents prone zones temporal data like year, month, day, hour, and date, environment variables like weather, temperature, and lightness, road conditions like surface type, road width, walkways, junction types, traffic lights, speed limits, road works, heavy and light traffic volumes etc, the accident type like turn and hit, overtake, animal hit, the number of injuries, casualties, vehicle type and so on (Ayramo et al., 2009). The workflow is based on the client server architecture. There are three types of architectures i.e. Client, Middle and database tier. Client tier architecture is basically for users in order to display information both geospatial & non-spatial and geographic & non-geographic information with the help of web browser e.g. chrome, Firefox etc. Client retrieves and extracts all information via user interface. Middle tier architecture provides a connection link between database tier and client through HTML and SQL. Here open layers is attached for map visualization on the web browser over the network. One important components of web development is Web server. Without this server, users can’t access information over the web. It enables the information via WWW protocol over the web. Apache Web server is a well known and high performance open source (freely available source code for modification) web server. Python is used as a scripting language on the server side. Earlier PHP (Hypertext Processor) was used as a scripting language. Basically both are used for web development but the difference is that PHP works on the core language of server side while the python works with add on modules with CGI (common gateway interface) capabilities. On the basis of that Python provides more flexible way for web development. Python embedded in web server process e.g. PHP and run in separate process. Python supports a large number of geospatial functions with fast speed and saves time. PostgreSQL/PostGIS are used for database and provide spatial database management. When client requests web page, web server executes the scripts and retrieve information from database created on PostgreSQL/PostGIS. Lastly, Web based GIS is developed with the high performance hardware and software tools in order to provide easily access all functions to users and enables users to extract information from database over the web. Figure 1 shows architecture of proposed solution.
IV. CONCLUSIONS & FUTURE WORK

This paper summarizes a theoretical and practical review of web based technology in the road accidents, accident analysis and reporting etc. that is integrated with GIS Technology. A real time dynamically changing traffic flows with shortest path analysis provides optimal routing in case of traffic congestion which is previously implemented. An example of optimal path to control traffic on the basis of optimal distance, minimum travel time and average speed is already presented as a web based. Open source software makes more enhancements for updating data in road management system and provides decision support system for road maintenance. Data integration enables better & faster decision on data from heterogeneous sources and provides saving in time and money. Real time traffic prediction is introduced for the transition period from free flow to congested traffic. After traffic control, emergency management is very important. Some web based work has also been done on traffic safety evaluation system or emergency management system. Many web-based solutions have also been provided to extract and retrieve important information through a framework. A lots of web-based calculations has also been done on injury rate, fatality rate etc. Crash data collection and management from end to end enables a web based solution providing all important information.

Future research will update security issues to make it as private-prone. Accuracy may be improvised by the enhancement of developed or prediction model based on real time dynamic traffic system and mapping of road accident risk. Map generator needs to be extended with regards to more efficiency and less time for large records. Database updating will improve in future surveys by providing collaborative single system. Data quality for visualization should also be improved. Large value of judgments, functions based on Geo-computational tools e.g. data conversion etc. should also be added to improve the accuracy. UML diagram should also be improved for future research work.

REFERENCES


