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Study of UML Architecture for Designing Advanced Accident Information System

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Abstract: Increasing Private and public vehicles have caused the increasing rate of accidents. In that case, an up to date and effective use case and class diagram will play a very important role to enhance accident or traffic related information management system to acquire or achieve requirements of traffic level reduction, travel time prediction, and shortest path analysis. A centralized information system can provide the solutions to all queries related to traffic, route and obstruction analysis via retrieving updated information, regular monitoring and controlling traffic from a centralized system. In order to develop that centralized information system for traffic and road accidents, UML (Unified Markup Language) has been proposed in this article to understand pre and post accident information via use case and class diagrams. These diagrams have provided all information related to road, weather conditions or many other factors for pre and post accident analysis. With the help of these diagrams, a multipurpose accident information system can develop over the web to provide all road accident information before accident and resource allocation after the accident.

This is the enhancement in UML diagram of earlier accident related information system by adding more attributes or facilities of emergency response system. So, it is termed as UML diagram for advanced accident information system. Pre-accident analysis includes traffic, obstacle, shortest route analysis etc. and post-accident analysis includes emergency response i.e. ambulance and other services. A use case diagram and class diagram into different forms has been proposed to achieve an effective design of advanced accident information system. A use case diagram on the basis of attributes has been designed to achieve to get all information for best route selection in case of traffic or obstacle with all safety and emergency response factors. Class diagrams have been divided into different categories i.e. an overview of advanced accident information system, accident identification, accident location with vehicles & victims details, and classification of a total number of accidents according to different types. These class diagrams have been designed on the basis of attributes of entities and operations based on the object-oriented methodology. Component and attribute based designs help to reduce complexity or increase modularity. Effective and understandable design for advanced accident information system enables the passengers and vehicle owner to choose their route with minimum travel time. It is also very beneficial in planning phase where database requirements need to understand and analysis phase after developing an effective advanced accident information system. It also fulfils all safety or security related information. Requirement, implementation, testing and verification phase are the part of planning phase which depends on these designs. It will prove very effective or beneficial for future accident related information system and emergency response system. So, a use case diagram with different forms of class diagrams has been proposed using attributes, entities, and operations for advanced road accident information with safety or emergency response factors with the help of IRC (Indian Roads Congress).

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Keywords- UML, ArgoUML, Astah Community, Advanced Traffic Management System, Accident Information Management System and Indian Roads Congress**.**

INTRODUCTION

There are so many problems we are facing nowadays because of not having effective model and design for understanding attributes and operation. For many real time applications like transportation, traffic etc. effective distribution of attributes according to your available data is very necessary. A new design having different attributes and operations has been proposed using a new software system called Astah community. This is the software which is freely available and very efficient for all UML (Unified Markup language) diagrams e.g. use case and class diagram). The performance of diagram can be increased by adding a large number of attributes and operations. Here use case and class diagram have been presented on the basis of a number of attributes and operations needed to develop an effective accident information system. This can be used for large and complex networks. It can also be defined as a system to differentiate different classes on the basis of information availability. The main and important factor of implementing real time accident information system is dynamic based use case and class diagram of road accidents. It basically helps in understanding the implementation which is able to reduce complexity and increases modularity. Understanding of each module creates depth knowledge of implementation of real time accident information system. It could be possible from UML diagram only to identify, analyze, evaluation and calculation and finally face all relevant risks. These architectures are basically designed on the basis of Indian Roads Congress (IRC) i.e. IRC: 53-2012, A1 & A4 forms. IRC fulfills accident data requirements for all road safety officers with police, lawyers etc. Accident data fulfills the planning criteria for highway, education, and training. It consistently revised the accident reporting form according to data collection updates. It provides the facilities of accident reporting & recording, data
storage & retrieval, analysis, and dissemination system. Investigation to record accidents, information about accident spot/scene and cause of the accident is the necessary to generate a framework for road accident analysis. It provides the definition for road accident, fatality rate, injury rate, the number of vehicles etc. This paper also includes the attributes of advanced traffic management system (ATMS) which improves or enhances mobility, safety, efficiency and economic productivity and data collection from cameras, sensors etc. to gather information about different attributes. This paper also inherits some of the properties of accident Information Management System (AIMS) which concludes 3-Dimension plot, multiple GIS platforms and very powerful for accident management & analysis system for all GIS & non-GIS users. It also provides benefits from different modules e.g. accident Rate, collision Diagram etc. More study with proposed use case and a class diagram for advanced accident information system has been discussed and proposed in this paper. The main objective is to collect all traffic & accident data from primary & secondary sources and manage those data.

LITERATURE REVIEW

Component based design of traffic control system for greater networks to increase modularity and reduce complexity has been modeled via Petri nets using divide and conquer strategy with the association of time intervals and places to achieve

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the design of requirement to implementation [7]. With the use of high integrity software to keep the consistency of the formal design and implementation with the increasing complexity, a formal method of the design, implementation, testing and verification phase has been discussed [10]. On the basis of wide application, analysis and optimization in Beijing road traffic management, a business process model for Beijing road traffic law enforcement have been proposed to improve the service level of traffic department [11]. Real time data acquisition is demanding day by day. So, a real time web based data access system on the basis of cost effective tools has been discussed for watershed analysis by modeling the web to hydrological interface [1]. Increasing difficulties in UTS (Urban Traffic Systems) enables design, study and implementation more complex. An object oriented modeling methodology based on DSS (Decision support system) has been proposed to design and manage in new software environment [3]. An object oriented methodology and heterogeneous nature based simulation are proposed for the variation of dynamic characteristics of vehicles, complex traffic flow, vehicular interactions and especially mid-block & intersection flow modeling based on queue density to improve modularity, development time reduction and many more advantages [4]. The relation between land use and transportation interaction at both spatial and temporal scales i.e. both spatial dependency & heterogeneity variations is a very challenging task. So, a temporal with significantly analysis approach has been proposed to enhance the way of analysing i.e. systematically and interactively on the basis of different datasets and different scales for the land use and transportation interaction [2]. A deployment of mobile web services on police vehicles to avoid the threat & disturbance due to an accident that broadcasts the accident related information in case of the blocked road due to an accident so that the traffic route could divert has been proposed in the form of real world application [9]. A spatiotemporal population model especially for rescue planning process to get population information i.e. density via various statistical methods, the size of the population has been proposed in Java programming language flexibility for user's knowledge [5].

UML Implementation

It is basically implemented with the reference of many sources e.g. IRC: 53-2012 (Indian Road Congress) on the high performance based software e.g. Agro UML, Astah Community. It includes forms of road accident recording i.e. A1 and A4. These UML diagrams are created in order to fulfil the requirements of road safety officers, the police, research groups, politicians and the member of Public. Figure 1 represents the use case diagram of accident information system with safety & shortest path analysis diagram. This represents a subdivision of accident information system via vehicle owner which explains in two steps. First steps indicate requesting for best route in terms of shortest path, cost etc. via registering location, vehicle & owner information and road situation information to controller agent when traffic, obstacle, an accident occurs. Controller agent broadcasts information to region control agent, city control agent and intersection control agent to find an optimum route by blocking that route. The second step is to report an emergency in case of accidents via registering a complaint to the administrator by providing all information i.e. vehicle, road, weather, vehicle owner information etc. via SMS or call by requesting nearest hospital & police station. Administrator generates RTC report and orders dispatcher to allocate resource

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e.g. ambulance, food & shelter to vehicle owner by opening incident via incident id.

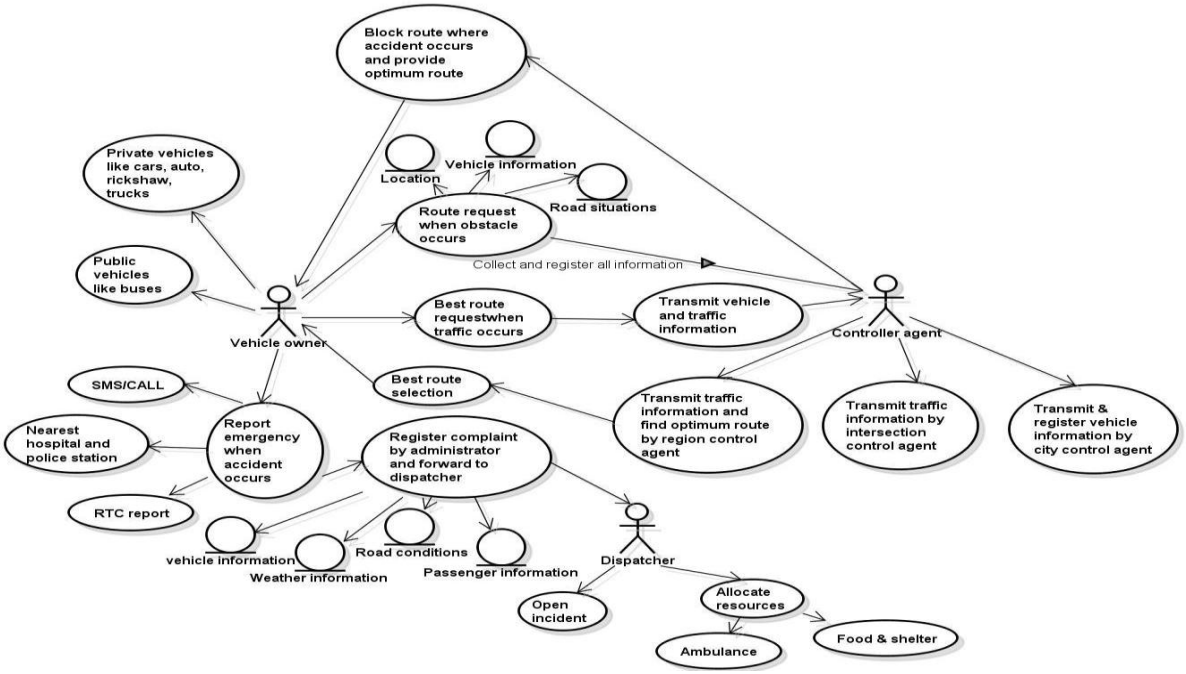

Figure 1 Use case diagram for Accident Information System

Figure 2 indicates class diagram of accident information system having entities and operation of different attributes e.g. vehicle, accident, accident type, GIS, SMS, call, controller agent i.e. vehicle agent, region controller agent, city center agent & intersection controller agent etc. and road safety officer

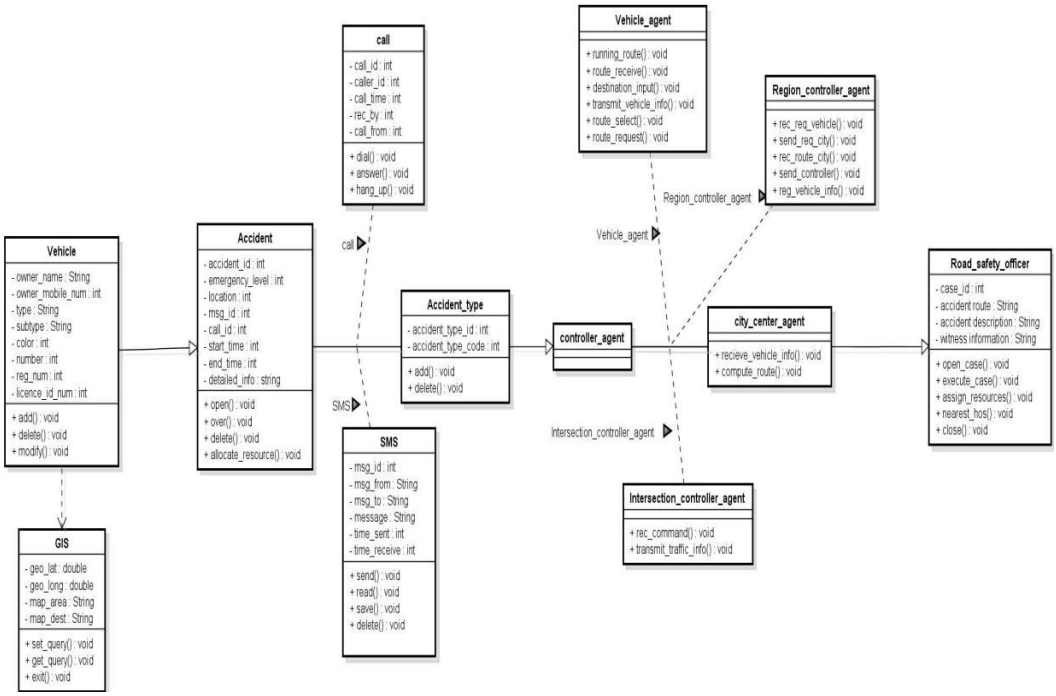

Figure 2. Class diagram of overview for Advanced Accident Information system

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Figure 3 indicates class diagram of accident identification according to the type of area, accident, weather, and collision.

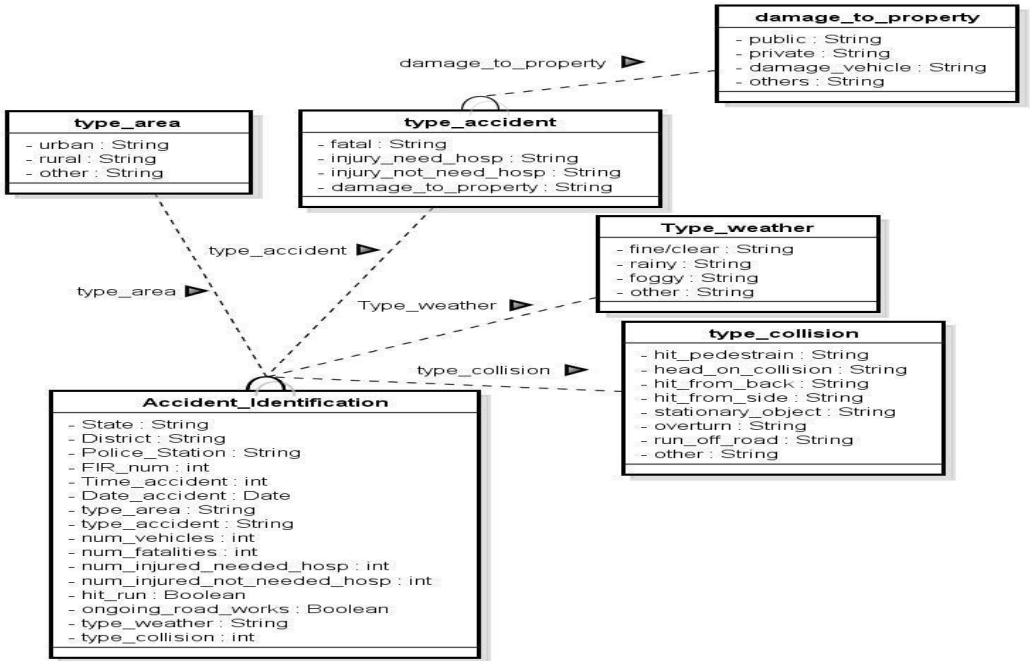

Figure 3. Class diagram for Accident Identification

Figure 4 indicates the class diagram of details of the accident location, vehicles of accident and victim of an accident. Accident location has been explained on the basis of different attributes e.g. road type, type of road surface and accident spot. The vehicle of the accident has been explained on the basis of disposition after the accident, traffic violation, and load condition and vehicle type. Victims of the accident have been explained on the basis of the presence of alcohol drugs, requisite of a safety device, type of injury, sex, and type of victim. Type of road has been classified on the basis of the express highway, national highway, state highway and many others. Type of road surface has been divided into two categories i.e. paved & unpaved. Road section & nearest junction has been found in the accident spot via police or any other sources. Disposition after an accident has decided whether roadworthy needs drove away or not. Traffic violation has been considered under different conditions i.e. over speeding, jumping in red light, wrong side driving etc. Load condition may be overloaded or normally loaded. Vehicle types have been assumed as private or public vehicles i.e. bus, car, motorized vehicles, trucks etc. Victims could be pedestrian, cyclist, passenger etc. in which injury is making sense of needing hospitalization or not. The investigation of alcohol presence or not plays a very important or effective role in road accidents (as shown in figure 4).

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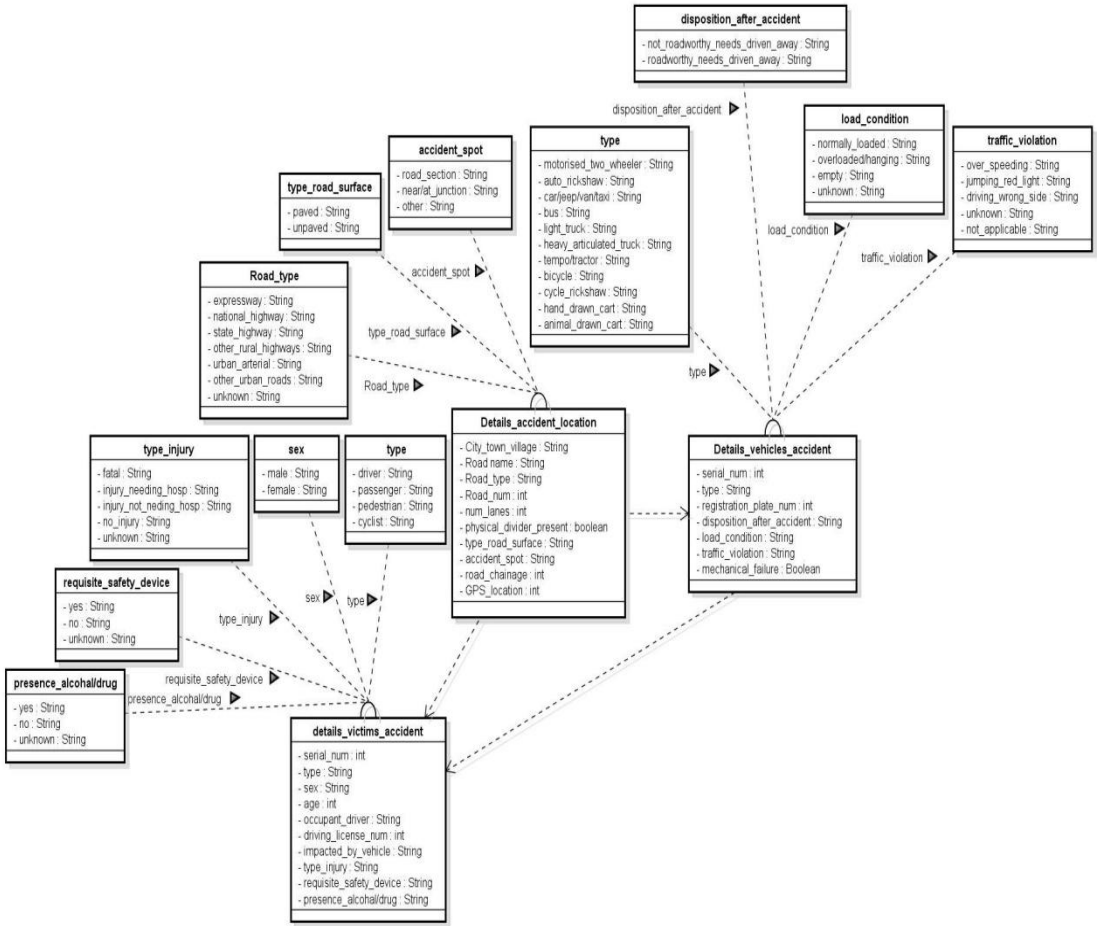

Figure. 4. Class diagram for details of accident location, vehicles of accident and victim of accident

Figure 5 indicates the Class diagram for the classification of a total number of accidents according to the month of the year, area type i.e. rural & urban & time, road classification, type of collisions, accident location or hot spot location, weather conditions and profile victim & alcohol drugs etc. The number of accidents in the rural and urban area has been calculated on the basis of a number of fatal injuries needing hospitalization or not, damage to property and total number. Time of accident has been approximately calculated. Roads have been classified in order to fulfill different categories i.e. expressway, national highway, state highway etc. Type of collisions has been explained in terms of a number of fatalities. Fatalities have been classified on the basis of hit pedestrian, head on collision, hit from back & side, stationary object, overturn and run off the road. The injury because of alcohol drugs and their safety device has been calculated. Weather conditions have been calculated on the basis of accident locations.

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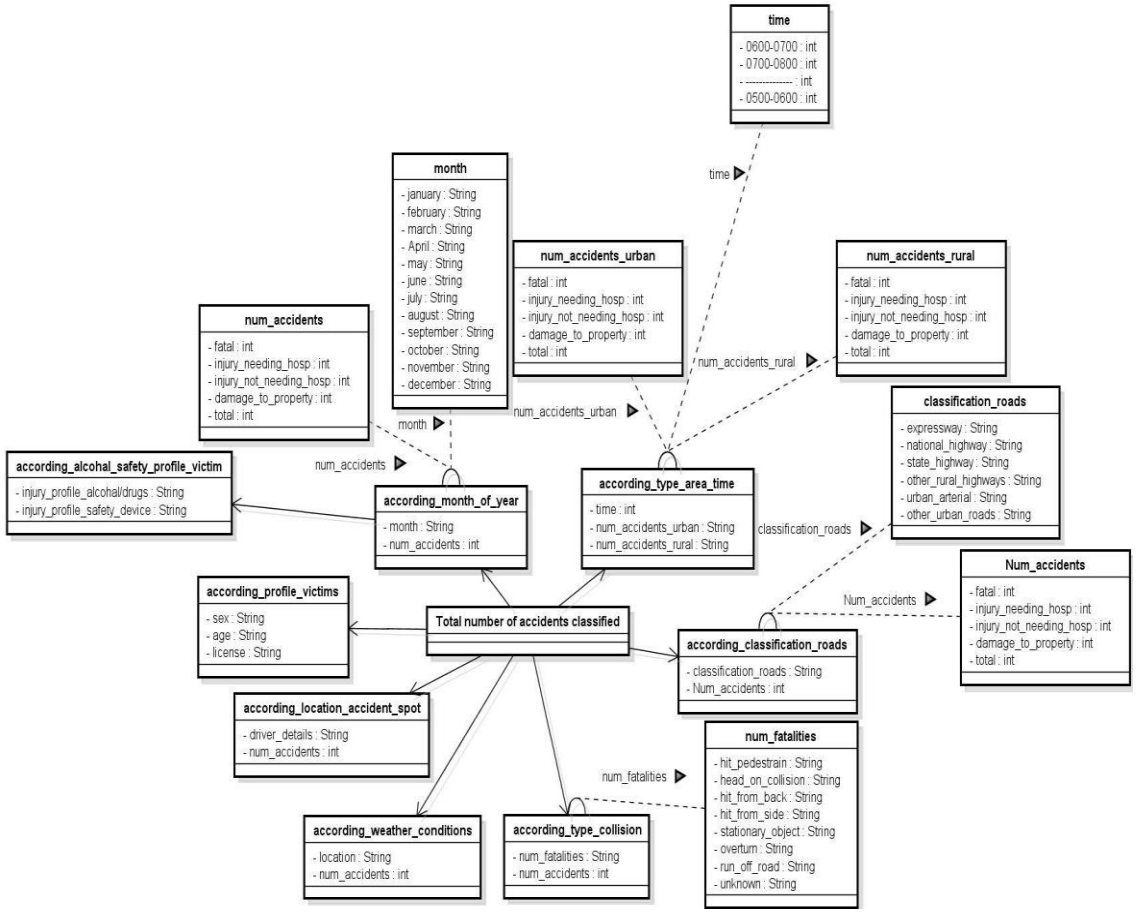

Figure 5. Class diagram for the classification for total number of accidents according to different types

CASE STUDY

Road Accident Collection and Management System in Korea [8].

Objective: - To develop Road Accident Collection and Management System in Korea.

Module: -

- Traffic Cop Information Management System (TCS)
- Traffic Accident Analysis System (TAAS)
- Transport Safety Information Management Complex System (TMACS)

Traffic Cop Information Management System **(TCS):-** TCS is composed of following 8 sub-systems i.e. Driving License System, Driver Penalty Point System, Traffic Enforcement System, Road Accident System, Driving School System, Road Repairing System, Statistics System, Miscellaneous System.

The function of road accident sub-system is as follows: Input of Road Accident Data, Linking and Checking with Related System, Analysis of Road Accident Data, Statistics, and Documentation.

Mapping of Road Traffic Injuries [6].

Objective: To assess the feasibility of using Geographical Information System for mapping of road traffic injuries with an existing data source in a developing country.

Methods: The study was a retrospectives case series of road traffic injury cases registered with the medico-legal office located in the three major trauma centers in Karachi for the period of

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January 1, 2004, till December 31st, 2004. Spatial data analysis was performed using ArcView 3.1.

Results: Out of 3650 of all road traffic injury, only 3% had locations detailed and accurate enough allowing mapping on a GIS map in the first attempt. Even after using detailed town maps and field exercises more than a quarter cases (n=1088; 30%) of road traffic injuries (RTIs) could not be properly located. We identified 25 areas of one kilometer or less in Karachi accounting for 27% of all RTIs. Five corridors of road measuring 27.7 km accounted for 590 (23%) of all RTIs with known locations.

Conclusions: Existing sources of data from the medicolegal system in Karachi failed to provide exact information on the crash site. Such datasets can, however, be used to define high-risk areas/neighborhoods.

Accident Information Management System [12].

Objective: - To develop an application for Accident Information Management System.

AIMS: - GIS is a GIS-based program originally developed for the City of San Francisco by JMW Engineering, Inc. The program runs on Windows 95 and uses MapInfo 4.1 to operate the GIS portion of the program. The program allows the user to select intersections or links by manual input or point and click selection from the map. Once an intersection or link is selected, a collision diagram can be generated. Other features of AIMS: GIS is the ability to plot worst accident locations, provide annual reports, and perform queries.

AIMS Options/Modules: Each module has different features i.e. Main Module, Collision Diagram Module, Accident Rate Module, Traffic Volume Module, Data Entry Module , GPS Module, Aerial Photograph Module, Network Module, Database Connection Module , Accident Report Image Module, Collision Diagrams on GIS Map Module, Collision Diagram Record Display Module, Code-To-English Conversion Module .

RESULTS AND DISCUSSIONS

In this paper, the utility of formal methods has been discussed for high integrity road accident information systems. A successful mapping has been done with the collaboration of formal method and implementation. It elaborates the capability of formal methods and explained the contribution of it to develop high-performance software system i.e. accident management, accident information system etc. It is possible to reduce faults occurred at the time of system updates for long term development system and cost reduction & guaranteed quality. Safety consideration is also made possible due to these formal UML diagrams. This is the key for all attributes, entities, methods, and functions so that analyzing, understanding and gathering data related to road accidents made possible.

Future research will be to enhance the whole architecture by activity diagram, deployment diagram, state machine diagram, and sequence diagram. Investigation of new techniques, revision of accident recording form according to requirements, appropriate technologies and criteria based enhanced design should be future research. Performance evaluation and code generation should be improved for modelling, analysis, and verification on the basis of proposed use case and class diagram.

CONCLUSIONS

Component based design proposed in this paper is able to improve accident related system for the greater network. Case and class activities are considered in the paper for understanding

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components, process descriptions and architecture flexibility related to pre and post related accident information system for large scale and complex network. The literature review also presented a framework on the different techniques. This study also enhances and knowledge on the safety and emergency response aspects. It also provides guidelines or standard for the purpose of research work. These designs are beneficial for accident reporting& recording, risk assessment, designing safety schemes or devices, Enforcement planning, education & training accident analysis, accident data storage & retrieval, emergency response etc. which are designed by high integrity software. Efficiency can be checked on the basis of the ability of road accident law enforcement strengthening and improvement used in IRC: 53-2012, A1 & A4 forms. Its efficiency also improves network performance with query improvement. These designs can help in saving a lot of time, cost and human efforts. Efficiency can be increased by taking the advantages of information technology related to data sharing. It offers benefits in flexible visual interaction in multimedia environments. It also facilitates guidelines to convert the formal method into system application architecture.

REFERENCES

1. Al-Sabhan W, Mulligan M and Blackburn G A 2003 A real-time hydrological model for flood prediction using GIS and the WWW. Computers Environment and Urban Systems 27: 9–32.
2. Shaw S L and Xin X 2003 Integrated land use and transportation interaction: a temporal GIS exploratory data analysis approach. Journal of Transport Geography. 11: 103–115.
3. Chabrol M, Sarramia D and Tchernev N 2006 Urban traffic systems modeling methodology. Int J Production Economics. 99: 156–176.
4. Gowri A, Venkatesan K and Sivanandan R 2009 Object-oriented methodology for intersection simulation model under heterogeneous traffic conditions. Advances in Engineering Software. 40: 1000–1010.
5. Zhang Z, Sunila R and Virrantaus K A 2010 Spatio-temporal population model for alarming situational Picture and warning system. The International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences. 38 Part II: 69-74.
6. Razzak J A, Khan U R and Jalal S 2011 Application of Geographical Information System (GIS) for mapping road traffic injuries using existing source of data in Karachi --a pilot study. J Pak Med Assoc. 61(7): 640–3.
7. Soares M D S and Vrancken J A 2012 Modular Petri net to modeling and scenario analysis of a network of road traffic signals. Control Engineering Practice. 20: 1183–1194.
8. Sul J and Oh L 2012 Road Accident (DTCatSa) Collection and Management System in Korea.
9. Arijo N H, Channa N, Pathan KT, Memon S A and Rajper N 2013 Modelling and Simulating Mobile Service-Oriented Systems. Sindh University Research Journal (Science Series). 45 (1): 75-78.
10. Cai H, Zhang C, Wu W, Hoa TK and Zhang Z 2014 Modelling High Integrity Transport Systems by Formal Methods. The 9th International Conference on Traffic & Transportation Studies (ICTTS'2014) Procedia - Social and Behavioral Sciences. 138: 729 – 737.

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www.rajournals.in

11. Li B, Zoz M and Guo Y 2014 Business Process Analysis and Optimization on Road Traffic Law Enforcement of the Beijing Intelligent Traffic Management. The 9th International Conference on Traffic & Transportation Studies (ICTTS'2014) Procedia - Social and Behavioral Sciences. 138: 748 – 756.
12. http://wwwjmwengineeringcom/aims00/aimshtml.