ABSTRACT

Traffic accident analysis is mainly intended to investigate the causes of accidents by identifying hazardous locations and Accident Prone Locations of accident occurrences and to analyze critically reasons attributing for the same so as to ensure road safety. Geographical Information System (GIS) technology has been a popular tool for visualization of accident data and analysis of hot spots in city as well as in highways. Accident analysis studies aims at the identification of high rate accident locations and safety deficient areas on the roads or streets. This paper presents a GIS based – Accident Analysis System developed for the Chennai city road network.

Traffic accidents are unavoidable in present traffic conditions. Hence it is necessary to manage the traffic accidents to reduce the loss of time, life and cost due to the accidents. Currently, law enforcement officers spend a considerable amount of time during an investigation of a traffic accident documenting evidence and measuring important scene characteristics. The investigation time needed for certain crash sites is reduced because taking photographs is quicker and simpler than employing other methods typically used, such as coordinate and the total station survey method. While studies have shown the benefits of other investigation techniques, notably Total Stations, it appears that photogrammetry has greater potential for reducing clearance times because of the small amount of time needed to take photographs (usually with a digital camera) of the accident scene.

Keywords: Road Traffic Accident Analysis – Photogrammetry Applications -- Geographical Information System (GIS) –Critical Accident Scene Analysis

1. INTRODUCTION

The continuous socio-economic growth over the years is causing an increase in demand for transport service including road transport .with the number of vehicles on the road growing rapidly, more road conflicts develops vis-a-vis traffic accidents. According to the recent WHO report, India has the highest number of road deaths in the world, followed by china, US, Russia. In India every year 1.43 lakhs of persons are reported to be killed and more even injured due to accidents on road. Tamilnadu has the first place in the country in accident risk index, and the number of accidents is estimated to increase three folds by 2020. The Road accidents also create enormous losses to the
Road traffic injuries are the eighth leading causes of death globally and the leading cause of death for young people. Current trends suggest that by 2030 road traffic deaths will become the fifth leading cause of death unless urgent action is taken.

Towards implementing traffic accident countermeasures effectively and efficiently, it is important to identify accident prone locations, to analyze accident patterns, and cause of an accident. The accuracy of measurements taken at a crash incident is an important consideration to the law enforcement officials, particularly if the crash involves a fatality or some criminal offense. However, in recent years, software applications incorporating GIS and Photogrammetry for investigation of traffic accident is still a relatively new practice. At this point, many police departments are still in the initial stages of using photogrammetry and therefore do not have a large amount of evaluation data to substantiate its effectiveness.

2. OBJECTIVES

- To create database of accident occurrences in different accident spots and analyse through ArcGIS platform;
- To find out the accident prone zone or black spots and accident black spots mapping would be created for Chennai city;
- To map the accident or crash scene and measurement of vehicle crush depth through advanced photogrammetric techniques.

3. DATA COLLECTION

3.1 GIS – Data Collection

Considering the development of road accident prediction model and analysis carried out to reduce the number of road accidents by using GIS, the following data like Number of accidents, Nature of accidents, exact location of accidents, Cause of accidents, Date and time of accidents, Vehicles involved in the accidents, Persons involved in the accidents, Faulty vehicles involved in the accidents are collected from Chennai City Traffic Police office located at Veppery in Chennai for the major roads of Chennai City which includes 100 Feet Road, 200 Feet Road, Anna Salai, EVR Salai, Thiruvotiyur High Road, CTH Road, EH Road, KamarajSalai, RajajiSalai, ECR Road, OMR Road, LB Road, SP Road, Santhome High Road, RadhakrishnanSalai, Velacherry Main Road, Tharamani Road, Arcot Road, Poonamallee High Road, New Avadi Road, Ambathur Estate Road, DurgabaiDeshmulk Road, SN Chetty Street, Ennore Express Road during the years 2010 to 2012.

3.2 Photogrammetry Data Collection

Photographs of the accident scenes and vehicle crash are used for finding cause of an accident or investigating an accident by close range photogrammetry. This is not limited to traditional film camera. The Video cameras, still video cameras, consumer 35mm cameras and digital cameras can also be used to perform 3D measurements using photogrammetric techniques. This Fig 3.1 shows the scene with the pickup truck in the foreground with skid marks and the Saturn sedan in the far background on the field. Fig 3.2 shows crushed car in an accident. These photos are taken from DCM Technical Service & Photomodeler.
4. DATA ANALYSIS

4.1 GIS –data analysis

Accidents data for three consecutive year viz. 2010, 2011, 2012 are been taken and fed into online ESRI ArcGIS software, for evaluation of accident data, comparison of the data, ratio of fatal and non-fatal accidents, vehicles involved in the accidents and finally the input data are represented in the form of map to generate information for public welfare about the most accident prone roads of Chennai. Also, the map will provide the alternative road to avoid crash and to reach the destination safely in more convenient way. The accident data collected has been analysed for observing the current trend of accidents in various roads. From the secondary data collected from the concerned authorities the prioritization of the spots is made. The secondary data collected includes details like year of accident, time of accident, type of accident, locality of accident, fault and victim vehicle involved in the accident, type of injury, etc.

This analysis reveals that pedestrians and two wheelers together form 73%, cars 17%, bicycle and buses 10% together contributing towards the total road accidents.
The fig 4.1 depicts year wise variation of accidents that occurred in the major arterial roads of Chennai. This analysis helps us to found the roads which are having maximum number of accidents.

![Fig 4.1](image)

**Fig 4.2** Accidents Distribution by Causative Factors In 2012

The fig 4.2 depicts the ratio of accident types that occurred in the year 2012. It has been found from the fig that careless driving and over speed leads to the maximum number of road accidents followed by rash driving and pedestrian accidents.

![Fig 4.2](image)

**Fig 4.3** Accident Zone /Spot Maps of Chennai City by ArcGIS

![Fig 4.3](image)
The fig 4.3 depicts the accidents data has been fed into ArcGIS map to mark black spots of Chennai city. If accidents occur in the same spot of road frequently, then that particular spot is called as Black spot. It indicates that a serious control measure is needed for those spots.

4.2 Photogrammetry data analysis

By using photogrammetry software the points are marked on the digital image (photograph). So that the depth of crush for particular vehicle involved in a crash has been shown to its corresponding Equivalent Barrier Speed (EBS) of the vehicle at the time of impact. So by measuring crush and combining this with knowledge about how the car deforms (i.e. how stiff it is) one can estimate the speed of the vehicle with its impact which is a crucial piece of evidence. This analysis was done for the Fig 3.2. These photos also taken from photomodeler/iWitness software.

![Fig 4.4 Marking on Digital Image by iWitness/Photomodeler Software](image1)

![Fig 4.5 Complete Crush Depth of Vehicle in 3D Diagram by Crash Zone Software](image2)
The fig 4.5 depicts the crush depth of the vehicle in 3D Diagram from this we can easily investigate the accident cause and speed of the vehicle involved in the accident. By using Fig 3.1 and 4.6 the crash scene were analysed based on the skid marks of the vehicle and by photomodeler software both 2D and 3D diagrams of the crash scene were exported. It is difficult to get the true shape of the skid marks in photographs taken at the ground level due to perspective distortion.

![Fig 4.6 Skid Marks on the Road](image1)

![Fig 4.7 2D diagram of crash zone](image2)

![Fig 4.8 3D diagram of crash zone](image3)

The 3D view of the 2D diagram in crash zone is useful for court and jury’s analysis and presentation.

**5. COMMENTS**

- This work gives an insight into the present scenario of the traffic condition of the areas and shows out the highly accident prone roads in the Chennai. It can also facilitate spatial data sharing within transportation agencies and transportation department and other government agencies.
Researchers found that the use of photogrammetric for investigation of traffic incident scenes is still a relatively new practice in India. In photogrammetry, fact can’t be hid and moreover the precise cause of the accidents could be very accurately found. It can be film-converted to digital format or digital camera images.”

Photogrammetry helps law enforcement officials to find out the real cause of an accident and also to map the accident scene by measuring the vehicle crush depth, skid marks, etc. in a precised manner with less time consumption.

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