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Investigation of Road Accident Zone and Suggestion for Preventive Measures by Using Gps and Gis Technology in Thanjavur, Tamil Nadu, India

Mr.M.Kannan,Ph.D
Head of the Department of Civil Engineering, PITS
Parisutham institute of technology and science
Thanjavur, Tamil Nadu, India.
kannanmaruthu2@gmail.com

G.Aakash
UG Student, Department of civil Engineering, PITS
Parisutham institute of technology and science
Thanjavur, Tamil Nadu,India.
aakashganesh121@gmail.com

***Abstract*—**Road accidents are the most unnecessary thing to happen to a public road user, though they ensue quite frequently. It harmfully impacts on a person, family unit and country's financial system as people may acquire injured or, in severe cases, he/she may fatality or property damage. Road accidents shall be controlled to minimize the loss of life and permanent disability. The most unfortunate thing is that we don't learn from our mistakes on the road. Most of the road users are quite aware of the general rules and safety measures while using roads but it is only carelessness on the part of road users, which cause accidents and crashes. Main cause of accidents and crashes are due to human errors. It can be achieved by analysis of accidental data. Global Positioning System and Geographical Information System (GIS) are among the best tools for analyzing and managing accidental data. In this research, the traffic accidents are analyzed police station-wise, vehicle type- wise, timewise, road-wise, etc. An endeavor is also made to identify the critical and most critical zones so that appropriate measures may be taken to check the accidents in prone areas. Survey and Video graphic analysis are also carried out to find out the locations of the nearest hospitals where the casualty can be hospitalized within 15 minutes of the accident

Keywords - Critical zone, GPS & GIS, Survey and Video graphic analysis

I. INTRODUCTION

Traffic accidents are an undesirable thing for road users, although they happen quite often. The main cause of accidents and breakdowns is human error. Let's examine some common human behaviors that lead to accidents.

1. Over Speeding
2. Drunken Driving
3. Distractions to Driver
4. Red Light Jumping
5. Avoiding Safety Gears like Seat belts and Helmets
6. Non- adherence to lane driving and overtaking in a wrong manner Various national and international researchers have found these as most common behavior of Road drivers, which leads to accidents.

i. Over Speeding

Most fatal accidents are caused by speeding. The natural psyche of people is to achieve access. If given the chance, one will surely reach infinite speed. But when we share the road with other users, we always end up behind one or the other vehicle. An increase in speed multiplies the risk of an accident and the severity of injuries during an accident. Faster vehicles are more prone to accidents than slower ones, and the severity of the accident is also higher in faster vehicles, and the severity of the accident is also higher in faster vehicles. The higher the speed, the higher the risk. At high speed, the vehicle needs a longer braking distance, or braking distance. A slower vehicle stops immediately, while a faster one takes a long distance to stop and also skids due to the law of long distance perception. A vehicle travelling at high speed has a greater impact during a crash and thus causes more injuries. The ability to assess future events also deteriorates when driving at higher speeds, which leads to errors in judgment and ultimately an accident.

ii. Drunken Driving

Drinking alcohol to celebrate a party is common. But when combined with driving, it turns the celebration into a disaster. Alcohol impairs concentration. It shortens the reaction time of the human body. It takes longer for the limbs to respond to the brain's instructions. It impairs vision due to dizziness. Alcohol suppresses fear and encourages people to take risks. All these factors lead to accidents while driving and often result in death. For every 0.05 increase in blood alcohol level, the risk of an accident doubles. In addition to alcohol, many drugs also affect driving skills and concentration. First of all, we recommend not consuming alcohol. However, if you feel that the fun is not complete without drinking, then do not drive under the influence of alcohol. Ask your friend to take you home.

iii. Distraction to Driver

While distraction while driving may be minor, it can lead to serious accidents. Riots can happen outside or inside the vehicle. The biggest distraction today is talking on a cell phone while driving. Talking on the phone takes more of your brain and less of your driving skills. This brain division impairs reaction time and decision making. This becomes one of the causes of accidents. Do not engage in conversations while driving. In case of an emergency call, you must leave the road and attend the call. Some attractions along the way include:

1. Adjusting mirrors while driving
2. Stereo/Radio in vehicle
3. Animals on the road
4. Banners and billboards.

The driver's attention must not be distracted by these things and reduce the speed to be safe during deviations and other external distractions.

iv. Red Light jumping

At highway intersections, it is a common sight that vehicles pass without paying attention to the light. The main motive behind jumping a red light is to save time. The common perception is that stopping at a red light is a waste of time and fuel. Studies have shown that traffic lights that all drivers follow correctly save time and get commuters to work safely and on time. A red light jumper not only endangers his life, but also the safety of other road users. That action by one driver encourages

another driver to try it and then causes chaos at the intersection. This chaos at the intersection is the main cause of traffic congestion. Eventually, everyone will be late to destination. A red light jumper has also been seen crossing the junction at higher speeds to avoid collision and challan, but this hampers his ability to judge the oncoming traffic and crashes quite often

II. DETRIMENTAL EFFECTS OF TRAFFIC ON ENVIRONMENT:

1.Safety 2. Noise 3. Land Consumption 4. Air Pollution 5. Degrading the Aesthetics

A. *Different factors of Roads contribute in Accidents:*

- *Drivers:* Speeding, reckless driving, breaking rules, not understanding signs, fatigue, alcohol
- *Pedestrian*: Carelessness, illiteracy, crossing the road at the wrong places, Jaywalkers..
- *Passengers*: Projecting the body outside the vehicle, talking to drivers, exiting and entering the vehicle from the wrong side, riding on footboards, catching a running bus, etc.
- *Vehicles*: Brake or steering failure, flat tire, insufficient headlights, overload, protruding loads.
- *Road Conditions*: Potholes, damaged road, connecting corroded roads to highways on country roads, detours, illegal speed bumps.
- *Weather conditions*: Fog, snow, heavy rainfall, wind storms, hail storms.

B. *Preventive measures for accidents:*

1. Education and awareness about road safety
2. Strict Enforcement of Law
3. Engineering:

(a) Vehicle design (b) Road infrastructure

C. *Objectives:*

- Detailed studies related to road accidents.
- Detailed studies in past and recent road accidents in and around the study area.
- Zone map preparation in 1:50,000 scale.
- Assessment and Analysis of accident zone prone area
- Caution of Road accidents
- Suitable preventive measures with suggestions

III. REVIWE OF LITERATURE

1. *Cheng, M., et al. (2017). Application of GPS and GIS in Road Traffic Accident Analysis. International Journal of GEOMATE* - In the recent years the number and speed of vehicles have been increased and the quality of roads and safety standard of vehicles are being optimized to a desired level by using various methods. In addition, the road users are being educated to improve their behavior in terms of safe driving. This study has shown how to reduce the traffic accidents on selected stretches in urban context. The goal of this paper is to analyze traffic accidents in selected stretches i.e. Miyapur to kukatpally, Dilsuknagar to Chaderghat, RTC X-road to Secunderabad, Afzalgunj to Puranapul, which are affected due to traffic congestion using GIS in the City of Hyderabad. The first part of the study investigated identification of maximum number of accidents in selected areas, accident victim wise, accident accused vehicle wise, accident day wise, accident by age wise, accident by hour wise, accident by drunk and drive wise etc. The second part of the study investigated collection of spatial data and non spatial data for identification of traffic accident black spots. The third part of the study investigated the development of spatial and attribute database to minimize the traffic congestion and to suggest the alternate route to prevent accidents. The last part of the study investigated the development of processing tool to create black spot analysis by Kernel Density Estimation method using GIS to reduce traffic accidents. The study suggested several improvements that can be implemented in order to have a more user-friendly and automated system and to make data accessibly for all the road users and to implement various procedures to provide more safety on roads.
2. *Zhang, Y., et al. (2018). Predictive Modeling of Road Traffic Accidents: A GIS-Based Case Study in Zhejiang Province, China. Sustainability*, -Road traffic accidents (RTAs) pose a significant threat to public safety and have become a major concern in many regions, including Zhejiang Province, China. Predictive modeling of RTAs is essential for identifying high-risk areas and implementing targeted interventions to reduce accident rates. This study presents a GIS-based predictive modeling approach to analyze and predict RTAs in Zhejiang Province. The study utilizes spatial analysis techniques to identify spatial patterns and hotspots of RTAs based on historical accident data. Various factors, including road characteristics, traffic volume, and environmental conditions, are incorporated into the predictive model. The results show that the GIS-based predictive model can effectively identify high-risk areas and provide valuable insights for road safety planning and management. The study highlights the importance of integrating GIS technology into road safety research and emphasizes the need for proactive measures to reduce the incidence of RTAs in Zhejiang Province, China
3. *Haque, M. M., et al. (2018). Real-Time Traffic Management Using GIS and GPS Technologies: A Case Study of Dhaka City. Journal of Traffic and Transportation Engineering (English Edition),* - Traffic management methods aim to increase the infrastructure's capacity to lower congestion levels. Using vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-everything (V2X) connectivity technologies, connected autonomous vehicles (CAVs) have the potential to operate as actuators for traffic control. In this study, a CAV-based alternative approach for traffic management is proposed, and its performance is compared to that of lane control signals (LCS) and variable speed limits

(VSL), which are also traffic management systems. When a shockwave is detected due to an incident, the CAVs on the road slow until they reach the speed of the observed shockwave (SWS), according to this proposed procedure. Thus, the incoming traffic flow towards the incident is slowed, preventing the queue behind from extending. In a simulation of the urban mobility (SUMO) environment, the suggested method is evaluated for 4800 scenarios on a three-lane highway by varying the market penetration rate of CAVs in traffic flow, the control distances, the incident lane, and the duration. The proposed method reduces the incidence of density values of over 38 veh/km/lane and 28 veh/km/lane in the vicinity of the incident region by 12.68 and 8.15 percent, respectively. Even at low CAV market penetration rates, the suggested technique reduces traffic density throughout the network and in the location of the incident site by twice as much as the LCS system application.

4. *Yang, Z., et al. (2019). Study on Emergency Rescue Path Optimization of Urban Traffic Accidents Based on GIS and GPS. Journal of Advanced Transportation,* - Emergency response activity relies on transportation networks. Emergency facility location interacts with transportation networks clearly. This review is aimed to provide a combined framework for emergency facility location in transportation networks. The article reveals emergency response activities research clusters, issues, and objectives according to keywords co-occurrence analysis. Four classes of spatial separation models in transportation networks, including distance, routing, accessibility, and travel time are introduced. The stochastic and time-dependent characteristics of travel time are described. Travel time estimation and prediction method, travel time under emergency vehicle preemption, transportation network equilibrium method and travel time in degradable networks are demonstrated. The emergency facilities location models interact with transportation networks, involving location-routing model, location models embedded with accessibility, location models embedded with travel time and location models employing mathematical program with equilibrium constraints are reviewed. We then point out the-state-of-art challenges: ilities-oriented, evolution landscape and sequential decision modelling, data-driven optimization approach, and machine learning-based algorithms.
5. *Li, J., et al. (2019). GIS-Based Road Traffic Accident Analysis and Prevention Strategies. International Journal of Environmental Research and Public Health,* - Understanding the spatial–temporal distribution characteristics of urban road traffic accidents is important for urban road traffic safety management. Based on the road traffic data of Wales in 2017, the spatial–temporal distribution of accidents is formed. The density analysis method is used to identify the areas with high accident incidence and the areas with high accident severity. Then, two types of spatial clustering analysis models, outlier analysis and hot spot analysis are used to further identify the regions with high accident severity. The results of density analysis and cluster analysis are compared. The results of density analysis show that, in terms of accident frequency and accident severity, Swansea, Neath Port Talbot, Bridgend, Merthyr Tydfil, Cardiff, Caerphilly, Newport, Denbighshire, Vale of Glamorgan, Rhondda Cynon Taff, Flintshire and Wrexham have high accident frequency and accident severity per unit area. Cluster analysis results are similar to density analysis. Finally, the temporal distribution characteristics of traffic accidents are analyzed according to month, week, day and hour. Accidents are concentrated in July and August, frequently in the morning rush hour and at dusk, with the most accidents occurring on Saturday By comparing the two methods, it can be concluded that the density analysis is simple and easy to understand, which is conducive to understanding the spatial distribution characteristics of urban traffic accidents directly. Cluster analysis can be accurate to the accident point and obtain the clustering characteristics of road accidents.

IV. STUDY AREA AND METHODS

A. Hotspot of the Study area

Table 1 Hotspot of the Study area

HOTSPOT	LATITUDE	LONGITUDE	TYPE OF HOTSPOT
Soorakottai bus stop	10.782566	79.197317	Public road crosses and bus over speed
Echankottai	10.66438	79.155974	All type of vehicle over speed
Kulichapatu cut road	10.782566	79.197317	Road cross
Thanjavur to Kumbakonam road kadakadappai cut road	10.79963	79.17708	Heavy vechicle over speed
Opposite Kuzhanthai Yesu church	10.75784	79.12508	Major junctiom
Tamil University,Thondri Amman opp	10.73400	79.09762	Main road to service road

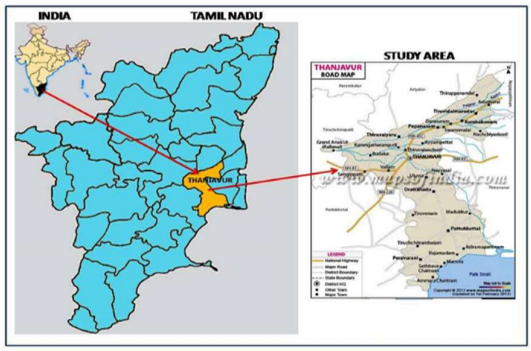

Figure 1 Location Map of Study Area

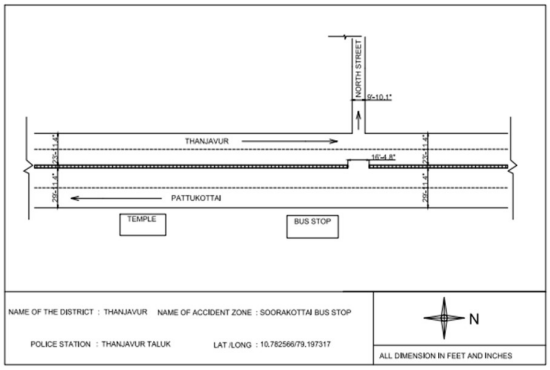

FIGURE 2 SOORAKOTTAI BUS STOP

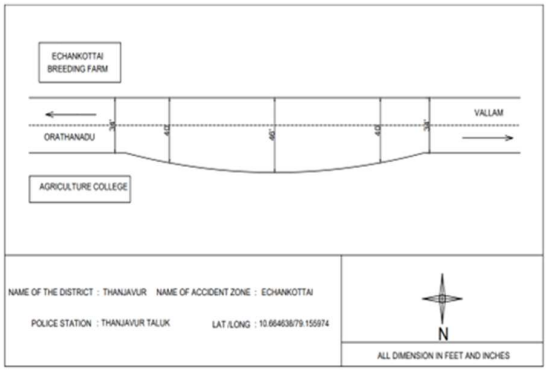

FIGURE 3 ECHANKOTTAI

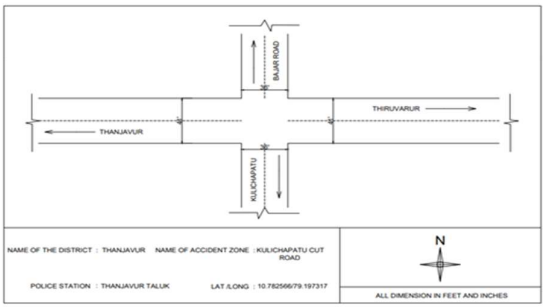

FIGURE 4 KULICHAPATU CUT ROAD

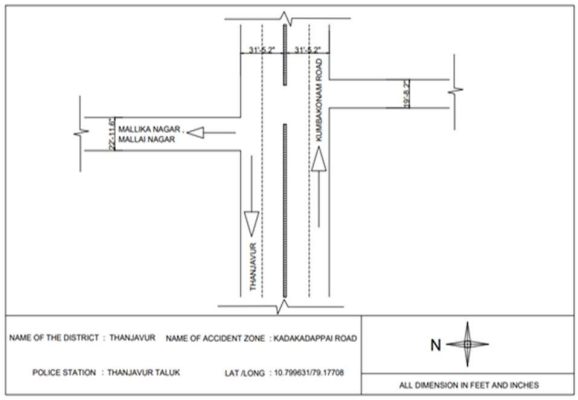

FIGURE 5 THANJAVUR TO KUMBAKONAM ROAD KADAKADAPPAI CUT ROAD

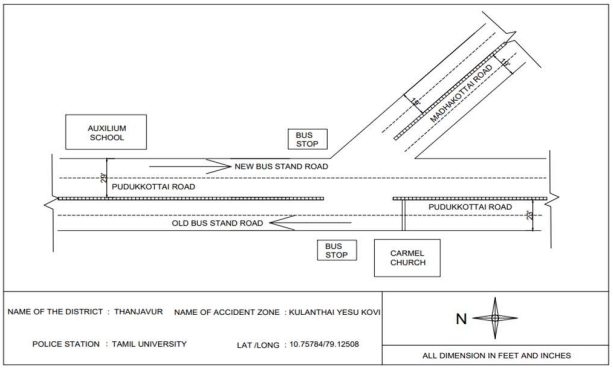

FIGURE 6 OPPOSITE KUZHANTHAI YESU CHURCH

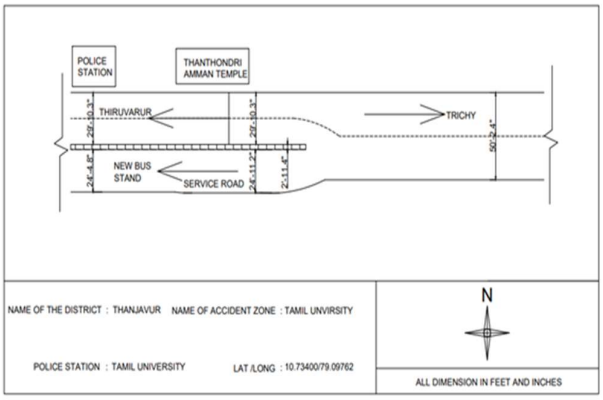

FIGURE 7 TAMIL UNIVERSITY,THONDRI AMMAN OPP

B. Method

Video-graphy survey for traffic involves using video cameras to capture and analyze traffic patterns, vehicle movements, and road conditions. This data can be used to understand traffic flow, identify congestion points, analyze driver behavior, and assess road safety. Video-graphy surveys are often conducted at intersections, highways, and other key locations to gather data for traffic management and planning purposes. This data can be further analyzed using GIS (Geographic Information System) technology to generate.

To conduct a video-graphic survey for the movement of vehicles, you can follow a systematic approach using cameras and software tools for analysis. Here's a general formula or methodology you can consider:

1. *C*amera Setup:

Install cameras at strategic locations along the road to capture vehicle movements. Consider factors such as visibility, angle of view, and coverage area.
Use high-resolution cameras capable of recording clear and detailed footage.

2. *Data Collection:*

Record video footage continuously or at specific intervals, depending on the duration of your survey and the level of detail required.
Ensure that the camera settings (e.g., frame rate, exposure) are optimized for capturing vehicle movement accurately.

3. *Video Analysis:*

Use video analysis software or tools to process the recorded footage. Popular software options include OpenCV, MATLAB, or specialized traffic analysis software.
Extract relevant data from the videos, such as vehicle count, speed, type of vehicles (e.g., cars, trucks), and direction of movement (e.g., incoming, outgoing).

4. *Data Processing:*

Organize the extracted data into a structured format, such as a spreadsheet or database, for further analysis.
Calculate metrics such as average vehicle speed, traffic volume (vehicles per hour), and peak traffic hours based on the collected data.

5. *Traffic Flow Analysis:*

Analyze the traffic flow patterns using the processed data. Identify congested areas, traffic bottlenecks, and peak traffic times.
Use visualization techniques (e.g., flow diagrams, heat maps) to present the traffic flow data effectively.

6. *Reporting and Recommendations:*

Prepare a detailed report summarizing the findings of the video-graphic survey. Include statistical analysis, graphical representations, and insights gained from the traffic flow analysis.
Based on the survey results, provide recommendations for optimizing traffic management, improving road safety, and enhancing overall traffic efficiency.

7. *Validation and Quality Assurance:*

Validate the accuracy and reliability of the survey data through spot checks or comparison with manual observations.
Ensure that the video-graphic survey methodology complies with relevant standards and guidelines for traffic surveys.

V. CONCLUSION

The investigation utilizing GPS and GIS technology has provided valuable insights into road accidents. Analysis of the data reveals that the majority of accidents occur at specific locations, indicating potential hotspots. Factors such as high traffic volume, road conditions, and lack of signage contribute significantly to these accidents.

GIS mapping has been instrumental in visualizing accident data, allowing for the identification of critical areas for targeted interventions. Additionally, GPS tracking has enabled the monitoring of vehicle speeds and routes, highlighting areas prone to reckless driving.

Based on these findings, several recommendations can be made to improve road safety. These include implementing traffic calming measures, improving road signage, and enhancing enforcement of speed limits. Furthermore, educating drivers about safe driving practices and the dangers of distracted driving can help reduce the number of accidents in the future.

In conclusion, the integration of GPS and GIS technologies has been instrumental in understanding the dynamics of road accidents. By leveraging these technologies, policymakers and urban planners can make informed decisions to enhance road safety and prevent future accidents.

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