Traffic Accident Analysis Using GIS- A Case Study

Authors

T Kiran Kumar¹, R Srinivasa Rao²

¹Post graduate student, Civil Engineering Deportment, GMRIT Rajam, AP, India
²Assistant Professor, Civil Engineering Deportment, GMRIT Rajam, AP, India

Email-¹kirankumar.tumati@gmail.com, ²srinivas.r@gmrir.org

ABSTRACT

Road accidents in the present era are contributing to major deaths due to increase in vehicular density. It has been predictable that over 3 lakhs persons die and 1.5 lakhs persons are injured every single year in road accidents all over the world. Based on the previous records it has been analyzed that in Visakhapatnam city 400 fatal and 850 non-fatal accidents were occurred in the last three years. The study area includes some major accident spots in East-2 traffic circle and North traffic circle, in Visakhapatnam city. The present work has been intended to identify accident spots in the study area by using collected police record data and to find optimized route between accidents spot to hospitals using Network analysis tool of Arc GIS-10.2.

Keywords- Traffic, Severity, Accidents Spots, Optimized Route, ArcGIS

INTRODUCTION

Transportation contributes to the financial, social, industrial and educational development of any country. Road transportation is the only mode that gives maximum service to one and all. Due to the increase in population, number of vehicles is also increasing day by day which leads to the increase in road network. It is observed that most of accidents are due to human mistake and carelessness on the part of the drivers. However, the probability of incident, and its severity, can often be reduced by the application of proper traffic control devices, and sound roadway design practice. The success or failure of such control strategy and design specifications however, depend extensively upon the analysis of traffic accident records at specific locations.

A geographic information system (GIS) is a computer system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data. GIS allows us to, understand, interpret, question, and visualize data in many ways that reveal relationships, patterns, and trends in the form
of globes, maps, reports, and charts. A geographic information system (GIS) is a powerful tool for managing large amounts of various data. Geographic Information systems (GIS) represent a powerful new means to efficiently manage and integrate the numerous types of information necessary for the planning, design, construction, analysis, operation, maintenance, and administration of transportation systems and facilities. In the present study, GIS analysis is performed using ARCGIS 10.2 package.

**OBJECTIVES**

1. To identify the accident spots on the road network by analyzing the collected police record data
2. To carry out analysis of accidents using GIS
3. To find optimized route from accident spot to hospital

**2. STUDY AREA AND DATA COLLECTION**

**2.1 Study Area**

Visakhapatnam also known as Vizag is the largest city in the state of Andhra Pradesh and the third largest city on the east coast of India (after Chennai and Kolkata). Visakhapatnam is located 17041’18” N, 83013’7” E with an area 544 km² with a population of 2,091,811 and occupying 681.96 sq.kms, it is the administrative headquarters of Visakhapatnam district the city is famous for its educational institutes and since it has become the capital, it has also become the hub of administration too. In Visakhapatnam city eight traffic circle zones, in these more number of accidents are in East-2 traffic circle and North traffic circle. Hence, these traffic circle zones have been selected as case study for analyzing accidents using GIS.

![Study Area](image-url)
1. Topographical map No: E44R6 from survey of India at the scale 1:50,000
2. Guide map of Visakhapatnam city from survey of India at the scale of 1:20,000
3. Accidents recorded from police control room of Visakhapatnam for the year of 2011-2013. The information collected is:
   - Type of accident
   - Name of the road
   - Time of accident
   - Name of accident

The Data collected from Visakhapatnam City according to FIR reports available at Traffic control room. The accident related information is multi-dimensional in nature, it is not possible to show all the information, hence as an illustration, the distribution of accident is shown as per type of accident only. All data characteristics of accidents are entered into the spatial database.

2.3 Yearly Distribution of Traffic Accidents in Visakhapatnam City

![Yearly Distribution of Traffic Accidents](image)

**Fig -2: Yearly Distribution of Traffic Accidents**

Above Fig-2 shows the yearly trends of traffic accidents in Visakhapatnam City from 2010 to 2013. Total 1599 fatal accidents with an average of 400 accidents per year and non-fatal 3879 accidents with an average of 970 accidents per year are observed.
2.4 Methodology

![Flow Chart Showing the Methodology adopted](image)

2.4.1 Map Scanning
The Survey of India topographical map at a sale of 1:50000 were scanned as the raster input.

2.4.2 Georeferencing
The Scanned map does not contain information as to where the area represented on the map fits on the surface of the earth. To create the relationship between an images coordinate system and a map(x, y) coordinate system need to align or georeference the raster data.

2.4.3 Digitizing
Digitizing is the process of converting analog information into a digital representation. Road network of the study area was digitized as line features. Accident locations are digitized as point features. The above spatial data were prepared in a personal geodatabase and feature class.
3. ANALYSIS AND RESULTS

On the basis of the data collected total of 3708 accident related injuries have taken recorded. It is observed that nearly 55.48% injuries are grievous followed by fatal injuries (31.48%). It show that rising out the type of accidents occurring in Visakhapatnam city, there is an urgent need to carry out proper traffic management studies in order to regulate the traffic. Table1 shows the distribution of different types of accidents in Visakhapatnam city during 2011-2013.

<table>
<thead>
<tr>
<th>Traffic zones in Visakhapatnam</th>
<th>Fatal</th>
<th>Non-Fatal</th>
<th>Injured</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>East-1 Traffic Circle Total</td>
<td>53</td>
<td>152</td>
<td>41</td>
<td>246</td>
</tr>
<tr>
<td>East-2 Traffic Circle Total</td>
<td>137</td>
<td>372</td>
<td>111</td>
<td>620</td>
</tr>
<tr>
<td>North Traffic Circle Total</td>
<td>135</td>
<td>303</td>
<td>55</td>
<td>493</td>
</tr>
<tr>
<td>South Traffic Circle Total</td>
<td>59</td>
<td>66</td>
<td>15</td>
<td>140</td>
</tr>
<tr>
<td>Gopalapatnam Traffic Circle Total</td>
<td>120</td>
<td>202</td>
<td>35</td>
<td>357</td>
</tr>
<tr>
<td>Steel Plant Traffic Circle Total</td>
<td>182</td>
<td>257</td>
<td>61</td>
<td>500</td>
</tr>
<tr>
<td>Gajuwaka Traffic Ps Total</td>
<td>135</td>
<td>282</td>
<td>80</td>
<td>497</td>
</tr>
<tr>
<td>Pm Palem Traffic Circle Total</td>
<td>344</td>
<td>422</td>
<td>89</td>
<td>855</td>
</tr>
</tbody>
</table>

Table -1: Total Accidents during 2011-2013

Fig-4: Distribution of Type of Accidents

Subsequently, on the basis of the data collected, the analysis was done for East-2 Traffic circle zone and North Traffic Circle zone so that temporal aspect of the accidents could be studied. Hence the analysis of data was carried out.
3.1 Accidents on yearly basis

Here the query was carried on the whole data set as per year and categorized as per level of injury. Fig 5 shows the procedure for query using ArcGIS in order to show the distribution of different levels of accidents injury under each police station from the years 2011-2013. However, the number of total accidents and grievous injury is continuously rising.

![Fig-5: Road accidents from 2011-2013](image)

3.1.1 Accidents 2011:-

It is clearly seen that maximum number of accidents occurs in the isukathota (26%), venkojipalem (21%), maddilapalem (23%), gurudwara jn (22%), Tc palem (22%), and Punjab hotel (27%).

![Fig-6: Road accidents in 2011](image)

3.1.2 Accidents 2012:- It is clearly seen that maximum number of accidents occurs in the isukathota (33%), venkojipalem (33%), maddilapalem (24%), Tc palem (19%), and kaparada (33%)
3.1.3 Accidents 2013:- It is clearly seen that maximum number of accidents occurs in the isukathota (37%), venkojipalem (19%), maddilapalem (30%), Tc palem (17%), bhurma camp (29%), and Birla jn (29%)

Above fig 5seen that maximum number of accidents occurred in national highway. It may noted that in Isukathota and Venkojipalem is highly populated area, their no traffic signals installed in these areas. In Maddilapalem commercial and educational institutes is more.

3.2 Accidents Analysis on Monthly Basis:-
Here the database has been queried for accidents as per month for the years 2011-2013 using the ArcGIS. This query yield results for accidents occurring in each month for the years 2011-2013 .It is clearly seen that the maximum number of accidents occurs in the month of September.
3.3 Optimized routes from accident spots to hospitals:

Network analysis in geographic information system (GIS) provides good decision support for users concerned in shortest or optimal route, finding the nearest facility and determines the service area. Searching optimal path is an essential analysis function in GIS. It is also one of the most important functions in GIS network analysis.

The accident spot is the origin and the nearby hospital is the destination, proper landmarks such as identifiable building, round turns, road junctions etc, have been identified and located along each road in order to specifically reach the accident spot. The place of accident is related to the nearest landmark in the road network.

**Fig-10: Traffic signals**

**Fig-11: Optimized Routes from accident spots to hospitals**
The outcomes are displayed graphically highlighting the route to be traversed indicating the locations of accident spot and hospital. In order to create the output more meaningful, the highlighted route is also described with regard to details like the road to start, the roads to traversed, turns to left or right and distance of travel along each road.

**Fig-12:** Direction to hospitals

**Fig -13:** Turns to hospitals
3.4 Discussions:-

Venkojipalem is highly populated built up area and located along the National Highway 5. Due to absence of traffic signal systems at this junction causes the accidents. Accidents in this area are due to uncontrolled traffic coming from MVP colony meeting the highway. Road joining from MVP is meeting the NH-5 at an inclination where there is no better view for the vehicles moving on National Highway with greater speeds. Position of bus stop is also one of the responsible for accidents to some extent.

Modifications suggested to Venkojipalem Junction:-

The only remedy possible to this junction is that the speed of the vehicles should be reduced by providing speed breakers as shown in Fig 14.

4. CONCLUSIONS

The study clearly indicate that as per accident records, there is an insistent need to adopt proper traffic management procedures to check the growth of accidents. Nearly 86.86% of accident leads to fatal and grievous injuries. Further it is observed that numbers of accidents are highest during the month of September. Maximum number of accidents occurred in national highway. It was observed that in Isukathota and Venkojipalem which are highly populated areas and there no proper traffic signals installed in these areas. In Maddilapalem many commercial places are noticed, which include shopping complexes, entertainment centers, and educations institutes is more. Gurudwara junction is very busy with traffic inflow and outflow due to many commercial places in this junction.

Extension of ArcGIS Network Analyst is aimed to solve routing problem efficiently and it also provides optimized routes. Route map and Directions output supply a substantial assistance to least travel time from
accident spot to hospitals. GIS has proved to be a good tool for analyzing multifaceted nature of accidents. This paper is a demonstration of application of GIS for developing an efficient database on road accidents taking East-2, North Traffic circle zones in Visakhapatnam city as a case study.

REFERENCES


[8]. Ganeshkumar, D.Ramesh “Emergency Response Management and Information System (ERMIS) A GIS based software to resolve the emergency recovery challenges in Madurai city, Tamil Nadu” International Journal Of Geomatics And Geosciences Volume 1, No 1, 2010

