Road Traffic Accident Analysis of Ajmer City, Using Remote Sensing and GIS Technology

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Student Category

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An **Accident** or a mishap is an unforeseen and unplanned event or circumstance, often with lack of intention or necessity.

It usually implies a generally negative outcome which might have been avoided or prevented had circumstances leading up to the accident been recognized, and acted upon, prior to its occurrence.

Injury prevention refers to activities designed to foresee and avoid accidents.

**Types**

1. Physical and non-physical
2. By activity
3. By vehicle

Physical examples of accidents include unintended collisions or falls, being injured by touching something sharp, hot, or electrical, or ingesting poison. Non-physical examples are unintentionally revealing a secret or otherwise saying something incorrectly, forgetting an appointment, etc.
Accidents during the execution of work or arising out of it are called work accidents.
According to the International Labour Organization (ILO), more than 337 million accidents happen on the job each year, resulting, together with occupational diseases, in more than 2.3 million deaths annually.
In contrast, leisure-related accidents are mainly sports injuries.

By vehicle

- Aviation accidents
- Bicycle accidents
- Sailing ship accidents
- Traffic collisions
- Train wrecks
- Tram accidents
Traffic Collision:

- A traffic collision, also known as a traffic accident, motor vehicle collision, motor vehicle accident, car accident, automobile accident, road traffic collision, road traffic accident, that occurs when a vehicle collides with another vehicle, pedestrian, animal, or other stationary obstruction, such as a tree or utility pole.
- Traffic collisions may result in injury, death, vehicle damage, and property damage.
- A number of factors contribute to the risk of collision, including vehicle design, speed of operation, road design, road environment, driver skill and/or impairment, and driver behavior.

Causes of Traffic Accident:

It is observed that most of the accidents result from human error and carelessness on the part of the drivers or pedestrians. However, the probability of occurrence, and its severity, can often be reduced by the application of proper traffic control devices, and sound roadway design practice.

In India 93% of crashes occur due to Human induced Factor (wholly or partly)
Road design

34% of serious crashes had contributing factors related to the roadway or its environment. Most of these crashes also involved a human factor.

Accident Analysis

➢ Accident analysis is carried out in order to determine the cause or causes of an accident or series of accidents so as to prevent further incidents of a similar kind. It is also known as accident investigation.
➢ It may be performed by a range of experts, including forensic scientists, forensic engineers or health and safety advisers.
➢ Systematic and scientific approach based on the use of accurate and reliable traffic accident data is required for such analysis.
USE OF GIS AND RS IN TRAFFIC ACCIDENTS

Building a geo-referenced accident database is the first step of GIS application in traffic accident.

The traditional accident database is a summary spreadsheet format using codes and mileposts to denote location, type and severity of accidents.

Geo-referenced accident database is location-referenced. It incorporates a GIS graphical interface with the accident information to allow for query searches on various accident attributes.

After having a geo-referenced accident database, we can use GIS based database to do some analysis, like:
- Identify accident historical trends
- Identify accident-prone locations
- Analyze relationships in accident causation - volumes, vehicle, road conditions, weather and lighting, etc.
OBJECTIVES

The objectives of the study are as follows:

1. Road accident analysis according to yearly and monthly variations for year 2009-2013.

2. To identify the traffic congestion areas at peak time: We will examine the traffic conditions in the areas where the traffic is heavy at a particular time, specially nearby schools, offices, etc.

3. Traffic accident analysis according to comparative vehicle wise (Heavy, Light and Medium Vehicle).

4. To prepare Land use/Land cover Map of study area.

5. To find the Accident prone site for study area: Here we will find the areas where most of the accidents are caused, as well as we’ll find the major cause of these accidents.
STUDY AREA

- Ajmer is the district of Rajasthan State. Ajmer City is a city of Ajmer district and the headquarter of district.
- Ajmer City is a religious and tourist place.
- It is surrounded by NH-8, NH-14, NH-79, NH-89. It has nine Police Station and one Mahila Police Station.
- All Nine Police Station Boundary of Ajmer City has been Selected for Study.

Location:
Ajmer city is surrounded by the Aravali hills. Ajmer City stretches from 26°26’ North to 26°23’ North and 74°36’ East to 74°40’ east.
In study, following data has been used:

1. **Satellite Data:**
   (i) Cartosat-1 (11 Dec 2011) data for Road Network, Rail Network and Land Use Land Cover.

2. **Ancillary Data:**
   (i) Police Station Control Area & their boundary.
   (ii) Road Accident Data From Police Stations.

3. **GPS Data:**
   (i) Police Station Location.
   (ii) Accident Location Data.

Various Information collected are:
- Type of Accident
- Type of Vehicle involved
- Name of the road
- Police Station area
- Time of Accident
- Date of Accident
### FIELD DATA RELATED TO ACCIDENTS

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Year</th>
<th>Number of Death</th>
<th>Number of Injured</th>
<th>Total Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2009</td>
<td>77</td>
<td>303</td>
<td>380</td>
</tr>
<tr>
<td>2.</td>
<td>2010</td>
<td>69</td>
<td>235</td>
<td>304</td>
</tr>
<tr>
<td>3.</td>
<td>2011</td>
<td>55</td>
<td>227</td>
<td>282</td>
</tr>
<tr>
<td>4.</td>
<td>2012</td>
<td>57</td>
<td>191</td>
<td>248</td>
</tr>
<tr>
<td>5.</td>
<td>2013</td>
<td>84</td>
<td>233</td>
<td>317</td>
</tr>
</tbody>
</table>

Total = 1531
Satellite Data

Rectification

Analysis of Cartosat-1 Data

Road & Rail Network Layer Extraction

LULC

Overlay of Spatial And Non Spatial Data

Data Base Query System

Final Tabular Data

Final Graphical Maps

Ancillary Data

Accident Data from Police Stations

Accident Spot Mapping using GPS

Toposheet (1:50,000)
Road accident is one of the major problems for most communities in developing countries which requires serious attention in searching for preventive measures to minimize this problem. To achieve the sustainable community road accident prevention.

An accident database must be firstly established. Unfortunately, most developing countries are facing the similar problem that traffic accident data are just merely statistics which will not lead to further analyses and detailed study.

Lack of accident database leads to the difficulty in searching for proper measures and is the major hindrance to create effective management of road accidents for communities.
Present research aims to solve this problem by creating the GIS road accident database for the selected study area, Ajmer City, Rajasthan.

It intends to make systematical use of the hospital's injury surveillance data.

On the basis of the data collected, total 1531 accident have recorded according to FIR reports available at various Police Station, during 2009 to 2013.

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.

However, all data characteristics of accident as listed above has been entered into the spatial database.
## Total Accidents During 2009-2013

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Police Station</th>
<th>Total Number of Accidents</th>
<th>Total Death</th>
<th>Total injured</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Civil Lines</td>
<td>281</td>
<td>55</td>
<td>226</td>
</tr>
<tr>
<td>2.</td>
<td>Adarsh Nagar</td>
<td>312</td>
<td><strong>106</strong></td>
<td>206</td>
</tr>
<tr>
<td>3.</td>
<td>Alwar Gate</td>
<td>209</td>
<td>52</td>
<td>157</td>
</tr>
<tr>
<td>4.</td>
<td>Clock Tower</td>
<td><strong>46</strong></td>
<td>7</td>
<td>39</td>
</tr>
<tr>
<td>5.</td>
<td>Ram Ganj</td>
<td>175</td>
<td>40</td>
<td>135</td>
</tr>
<tr>
<td>6.</td>
<td>Christian Ganj</td>
<td><strong>329</strong></td>
<td>53</td>
<td>276</td>
</tr>
</tbody>
</table>
## Total Accidents During 2009-2013

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Police Station</th>
<th>Total Number of Accidents</th>
<th>Total Death</th>
<th>Total injured</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Kotwali</td>
<td>131</td>
<td>20</td>
<td>111</td>
</tr>
<tr>
<td>8.</td>
<td>Ganj</td>
<td>55</td>
<td>7</td>
<td>48</td>
</tr>
<tr>
<td>9.</td>
<td>Dargah*</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

* The Dargah Police Station Area is a No Vehicle Entry Zone
Here the query was carried on the whole data set as per year and categorized as per level of injury and concerned Police Station.

The procedure for query using ARC GIS in order to show the distribution of different levels of accidents injury under each police station from the years 2009-2013 (as Table no.1).

It has been observed that the total number of accident for the particular year is more or less then same for the other year.

However, the number of total accidents and grievous injury is continuously increasing/ moderate.

Maps are a powerful and effective way to show what pattern is occurring with accident data spatially.
Accident Spot Location Map of Dargah Police Station (Year 2009-2013)

Accidents of Dargah Police Station

Legend
- Accident Spot
- Road Network
- Police Station Boundary

Data Source: Cartosat-1 (11 Dec 2011), Accident data from Police Station and mapping using GPS
Accidents of Ganj Police Station (Year 2009-2013)

Data Source:
Cartosat-1, Accident Data from Police Station, Accident Spot Mapping Using GPS

Legend
- Accident Spot
- Road Network
- National Highway
- Police Station Boundary
Accident Spot Location Map of Clock Tower Police Station (Year 2009-2013)

Data Source:
Cartosat-1, Accident Data From Police Station, Accident Spot Mapping Using GPS

Accidents of Clock Tower Police Station

Legend
- Accident Spot
- Road Network
- National Highway
- Railway Network
- Police Station Boundary

2009 2010 2011 2012 2013
Accident
Accidents of Ram Ganj
Police Station

Accident Spot Location Map of
Ram Ganj Police Station
Year (2009-2013)

Data Source:
Cartosat-1 (11 Dec 2011),
Accident data from Police Station
and mapping using GPS

Legend
- Accident Spot
- Road Network
- National Highway
- Rail Network
- Police Station Boundary
Accident Spot Location Map of Kotwali Police Station (Year 2009-2013)

Data Source:
Cartosat 1, accident data from Police Station, Accident Spot Mapping GPS

Accidents of Kotwali Police Station

Legend
- Accident Spot
- Road Network
- National Highway
- Police Station boundary

<table>
<thead>
<tr>
<th>Year</th>
<th>Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>32</td>
</tr>
<tr>
<td>2010</td>
<td>24</td>
</tr>
<tr>
<td>2011</td>
<td>20</td>
</tr>
<tr>
<td>2012</td>
<td>18</td>
</tr>
<tr>
<td>2013</td>
<td>17</td>
</tr>
</tbody>
</table>
Accidents of Adarsh Nagar Police Station

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>57</td>
</tr>
<tr>
<td>2010</td>
<td>40</td>
</tr>
<tr>
<td>2011</td>
<td>38</td>
</tr>
<tr>
<td>2012</td>
<td>28</td>
</tr>
<tr>
<td>2013</td>
<td>19</td>
</tr>
</tbody>
</table>

Location Spot Map of Adarsh Nagar Police Station (Year 2009-2013)

Data Source:
Cartosat-1 (11 Dec 2013), Accident data from Police Station and mapping using GPS

Legend
- Green dot: Accident Spot
- Blue line: Road Network
- Yellow line: National Highway
- Red series of dots: Rail Network
- Pink color: Police Station Boundary
Accident Spot Map of Alwar Gate Police Station (Year 2009-2013)

Accidents of Alwar Gate Police Station

Legend
- Accident Spot
- National Highway
- Road Network
- Rail Network
- Police Station Boundary

Data Source: Cartosat-1(11 Dec 2011), Accident data from Police Station and mapping using GPS

Accidents from 2009 to 2013:
- 2009: 38
- 2010: 47
- 2011: 33
- 2012: 29
- 2013: 46
Accidents of Civil Lines Police Station

Accident Spot Map of Civil Lines Police Station (Year 2009-2013)

Legend
- Accident Spot
- Rail Network
- Road Network
- National Highway
- Police Station Boundary

Data Source:
Cartosat-1 (II Dec 2011), Accident data from Police Station and mapping using GPS

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Here the database has been queried for accidents as per month for the years 2009-2013 using the ARC GIS. The procedure for calculation of monthly variations in accidents is shown in Figure.

This query yield results for accidents occurring in each month for the years 2009-2013.

It is clearly seen that the maximum number of accidents occurs at Adarsh Nagar Police Station in the month of March.

This could be due to large number of tourist vehicles, which pass through to the city, as Ajmer City is the gateway to Puskar and the national highway is also pass through this police station.

Monthly basis Analysis of Adarsh Nagar Police Station (2009)
Procedure for calculation of monthly variations
Monthly basis Analysis of Adarsh Nagar Police Station (Year 2010)

Monthly basis Analysis of Adarsh Nagar Police Station (Year 2011)
Monthly basis Analysis of Adarsh Nagar Police Station (Year 2012)

Monthly basis Analysis of Adarsh Nagar Police Station (Year 2013)
Monthly basis Analysis of Alwar Gate Police Station (Year 2009)

Monthly basis Analysis of Alwar Gate Police Station (Year 2010)
Monthly basis Analysis of Alwar Gate Police Station (Year 2011)

Monthly basis Analysis of Alwar Gate Police Station (Year 2012)
Monthly basis Analysis of Alwar Gate Police Station (Year 2013)
Monthly basis Analysis of Clock Tower Police Station (Year 2009)

Monthly basis Analysis of Clock Tower Police Station (Year 2010)
Monthly basis Analysis of Clock Tower Police Station (Year 2011)

Monthly basis Analysis of Clock Tower Police Station (Year 2012)
Monthly basis Analysis of Clock Tower Police Station (Year 2013)

Maximum Number of accidents in Clock Tower Police Station occurs at September.
Monthly basis Analysis of Kotwali Police Station (Year 2009)

Monthly basis Analysis of Kotwali Police Station (Year 2010)
Monthly basis Analysis of Kotwali Police Station (Year 2011)

Monthly basis Analysis of Kotwali Police Station (Year 2012)
Monthly basis Analysis of Kotwali Police Station (Year 2013)
Monthly basis Analysis of Ganj Police Station (Year 2009)

Monthly basis Analysis of Ganj Police Station (Year 2010)
Monthly basis Analysis of Ganj Police Station (Year 2013)
Accident Spots Location Map of Ajmer City in January Month (Year 2009-2013)

Data Source:
Catosat-1 (11 Dec 2011)
Accident data from Police Station and Mapping using GPS

Legend
- Accident Spot
- Road Network
- National Highway
- Rail Network

Scale: 0 5 10 20 30 40 KM
Accident Spots Location Map of Ajmer City in February (Year 2009-2013)

Legend
- Accident Spots
- Rail Network
- Road Network
- National Highway
- Police Stations Boundary

Data Source:
Cartosat-1 (11 Dec 2011)
Accident data from Police Stations and mapping using GPS
ACCIDENT ANALYSIS ON VEHICLE BASIS

The query to the database is performed using type of vehicle involved in accidents. The vehicles have been classified into three categories:

(a) Heavy Vehicles – Truck, Bus and Tractor.

(b) Medium Vehicles – Private Car, Jeep, Van, Auto-Rickshaw, Taxi, Pickup.

(c) Light vehicles – Motorcycle, Scooter, Cycle.

It can be clearly seen that medium type of vehicles are more involved in accidents as compared to other vehicles on the major city roads. This is due to the fact the normally tourists passing through the town are traveling in Cars, Taxis, Vans and Jeeps. Also, light vehicles are next in number with regards to accidents. The possible reason could be the availability of different types of motorcycles and scooters which high engine power and pick up capabilities. Another reason for such high number of accidents involving medium and light vehicles may be due to disregard for traffic rules. The remedial measures for enforcement of traffic rules have to be strictly enforced by traffic police.
It can be clearly seen that medium type of vehicles are more involved in accidents as compared to other vehicles on the major city roads. This is due to the fact the normally tourists passing through the town are traveling in Cars, Taxis, Vans and Jeeps. Also light vehicles are next in number with regards to accidents. The possible reason could be the availability of different types of motorcycles and scooters which high engine power and pick up capabilities. Another reason for such high number of accidents involving medium and light vehicles may be due to disregard for traffic rules. The remedial measures for enforcement of traffic rules have to be strictly enforced by traffic police.

On the other side the heavy type of vehicle are mainly involves on the National Highways and the many time the accident is cause of death. This is because many derivers are not follow the highway rules like lane rule.
Map of Accident Spot According to Vehicle Type
Kotwali Police Station
(2009-2013)

Legend
- Heavy Vehicle
- Light Vehicle
- Medium Vehicle
- Rail Network
- City Roads
- Major Roads
- National Highway
- Police Station Boundary

Data Source:
Accident data from Clock Tower Police Station and Spot mapping using GPS
SOI Toposheet
Map of Accident Spot According to Vehicle Type
Ganj Police Station
(2009-2013)

Legend
- Red: Heavy Vehicle
- Blue: City Roads
- Green: Medium Vehicle
- Purple: Major Roads
- Black: Rail Network
- Yellow: Police Station Boundary

Data Source:
Accident data from Clock Tower Police Station and Spot mapping using GPS
SOI Toposheet
Map of Accident Spots According to Vehicle Type
Civil Lines Police Station
(2009-2013)

Legend
- Heavy Vehicle
- Light Vehicle
- Medium Vehicle
- Major Roads
- National Highway
- City Roads
- Rail Network
- Police Station Boundary

Data Source:
Accident data from Cristian Ganj Police Station and mapping using GPS, SOI Toposheet

North
Accidents do tend to display a specific trend as per time of the day. The number of accidents occurring during the evening time is more than during the night time and day time. In this study, the time of accident occurrence has been split into four time stop.

4 AM to 10 AM – Morning Time (School and Office goers rush time).

10 AM to 4 PM – Day Time.

4 PM to 10 PM – House wife shopping rush and evening rush.

10 PM to 4 AM (next day) – Night time(Heavy loading trucks goers time)

The query to the database has been carried out as per time stop and categories as per level of injury incurred. It is observed that Maximum number of accidents occur during 4 PM to 10 PM, may be attributed to the combined rush in evening along with poor lighting. This gives a clear indication that proper traffic management along with proper street lighting is required.
Accident Spot Map of Ajmer City
Timely Basis
2009-2013

Legend
- Rail Network
- Road Network
- Ajmer City Boundary

Accident Spot
- Green: 10 PM - 4 AM
- Blue: 4 AM - 10 AM
- Purple: 10 AM - 4 PM
- Red: 4 PM - 10 PM

Kilometers
0 1 2 4 6 8
ACCIDENT PRONE SITE OF STUDY AREA

On the basis of total number of accidents occurred at Ajmer city, it is observed that maximum accidents occurs on the Ana Sagar Link Road, Nasirabad Road, Near Badliya Chauraha NH-8 and Beawar Road. The reason of such accidents occurred at Ana Sagar Link Road is busy route of city because the tourists comes to see Ana Sagar and to pray at Dargah and also this road is gateway to Pushkar city.

Nasirabad Road, Badliya Chauraha and Beawar Road are the main roads that connects the city with Highways.

Thus, we prepared an accident prone map of Ajmer City on the basis of collected data and on the basis on analyzing the datasets on yearly, monthly, timely and vehicle wise accidents for five different years (2009-2013).
We have prepared the database of accidents of Ajmer City and finally we observed that maximum accident occurred at the peak time, i.e. **4PM to 10 PM**. This can be the reason of maximum accident because it is the peak hour when most of the offices are being closed or people go for shopping. Heavy traffic and poor street lighting may be the cause for this.

We also found that maximum accident occur because common people do not follow the proper traffic rules and thus they face accident. So common people should follow the proper traffic rule and the local government also needs to prepare a proper plan like seminars can be arranged on Road Safety, thus reducing the accident rate.

The study clearly indicates that as per accident records, there is an urgent need to adopt proper traffic management procedures to check the growth of accidents. Nearly **23%** of accidents are cause of death. Further it is observed that number of accidents are highest during the month of **May** and second highest during **November**. This sudden increase in the number of accidents may due to tourit vehicles passing through Ajmer, as it is the gateway to Pushkar. This fact is further substantiated by the fact that the number of **medium type of vehicles** is higher than any other type of vehicle.
SUGGESTIONS

There are some causes of accidents and some suggestions, such as:

**Over loading:** passing through of marbles and cement carrying vehicles, truck & trailers are 20-25 times more overloaded than their capacity. Road cannot bears the weight of these overloaded vehicles.

**Uncontrolled Driving:** Trucks & trailers roughly pass through the highways that also cause accidents and damage to roads.

**Drink and Drive:** Road transportation department does not strictly check drunk driving.

**Speed and lane driving:** Vehicles are not running in proper lane as well as at proper speed according to RTO rules. There is no proper lane system. Awareness about lane system is lacking. There is no agency which is active in spreading awareness.

**Lack of Knowledge and mix traffic:** Improper knowledge of drivers also causes accidents on roads.

Compound wall both sides of highway should be about 12 feet but there is no such compound wall.

Most Countries have extra lane at highways which are called storage lane. Because if any vehicle stops then it can be placed in that extra lane and any other working vehicle cannot enter in that extra lane but in India when any vehicle stops, repairing starts on that movement, that cause inconvenience to others too.

People do not pay attention to the sign boards which are placed along the roads and their ignorance leads to accidents.
THANK YOU