

WEST BENGAL SURVEY INSTITUTE



APPLICATION OF GIS & REMOTE SENSING IN ACCIDENTAL ZONE

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I am making this project not only for marks but to also to improve our knowledge.

THANKS AGAIN TO ALL WHO HELPED US.

Abstract

Road traffic injuries are now regarded as the eighth leading cause of death globally. Also, pedestrian safety is a major and growing problem in Indian cities. The main purpose of this study is to identify and analyse the reasons for road traffic accidents in Kolkata, West Bengal, India. Also, this study investigates the different causes of accidents occurred in past years in Kolkata, West Bengal. Kolkata, was reported as one of the accident-prone zones in India with having highest rate of road accidents. This study investigates why Kolkata, reportedly came in top number of accidents. What are the reasons for occurring accidents and how can resistance the accidents?

These findings necessitated the development of the current study which focuses on the prime factors that cause this type of injuries. The current investigation examines crash data (2015–2020). The aim of this study, therefore, is to explore the behavioural factors that entail a higher risk of suffering either a serious or a fatal injury for drivers. The variables that define the model are grouped into four factors: vehicle factor, road factor, circumstantial factor and human factor.

Results. The results suggest that the principal variables that determine a higher probability of serious or fatal injuries in traffic injuries are: lack of using appropriate safety accessories, high-speed violations, distractions as well as errors. The study findings also show that high levels of pedestrian–vehicular interaction, road width, on-street parking, the absence or encroachment of a footpath, pedestrians' perceived difficulty of crossing, signal violations, post-encroachment time, and a number of spatial features such as slum population, share of working population, and population density significantly affect the frequency of fatal crashes involving pedestrians.

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INTRODUCTION

Kolkata is the capital of West Bengal state, and former capital (1772–1911) of British India. It is one of India's largest cities and one of its major ports. The city is centred on the east bank of the Hooghly River, once the main channel of the Ganga River, about 96 miles (154 km) upstream from the head of the Bay of Bengal; there the port city developed as a point of transshipment from water to land and from river to sea. A city of commerce, transport, and manufacture, Kolkata is the dominant urban centre of eastern India.

Kolkata, as Calcutta is called now, has the maximum number of travel options for intra-city or inter-city transportation. The circular rail and transport corporation buses cater to nearer destinations. Catamaran and ferry services exist for riverine traffic.

Public transportation, such as buses, trams, trains, and subways, are the principal means of transport in the Calcutta metropolitan area. Buses operate throughout the area, and trains have north-south lines with a few east-west connections.

There are two major train terminals Sealdah in the east central part of Calcutta and Howrah across the river from the Central Business District. Electric trams operate in Calcutta proper. The aging buses, trains, and tram cars suffer from overloading, creating uncomfortable rides. Subway construction started in 1972 and became operational with 7 km of line in 1984.

By 1995 all of the subway's 16.4-km route from Dum Dum to Tollygunge was completed. The subway carries an estimated 25 percent of Calcutta's 7 million commuters. Cycle rickshaws are not allowed in the city of Calcutta, but they are common in the metropolitan area. Hand-pulled carts are used for short-distance cargo hauling. Private automobiles, extensively used in Calcutta and Howrah, are increasing in numbers and are owned by the wealthy.

Air pollution caused by automobiles, buses, and industrial emissions is severe. Calcutta's international airport at Dum Dum is about 19 km from the city centre and provides service for both national and international airlines.

Objective

The principal goal of this study is to develop a systematic approach to identify and estimate the major sources of pedestrian risk factors at urban intersections in a developing country. To achieve this objective, it is necessary to identify the risk factors associated with

- (a) road infrastructure, planning, land use, traffic exposure, and operational characteristics
- (b) pedestrian behaviour and perceptions; and
- (c) spatial characteristics of intersections.

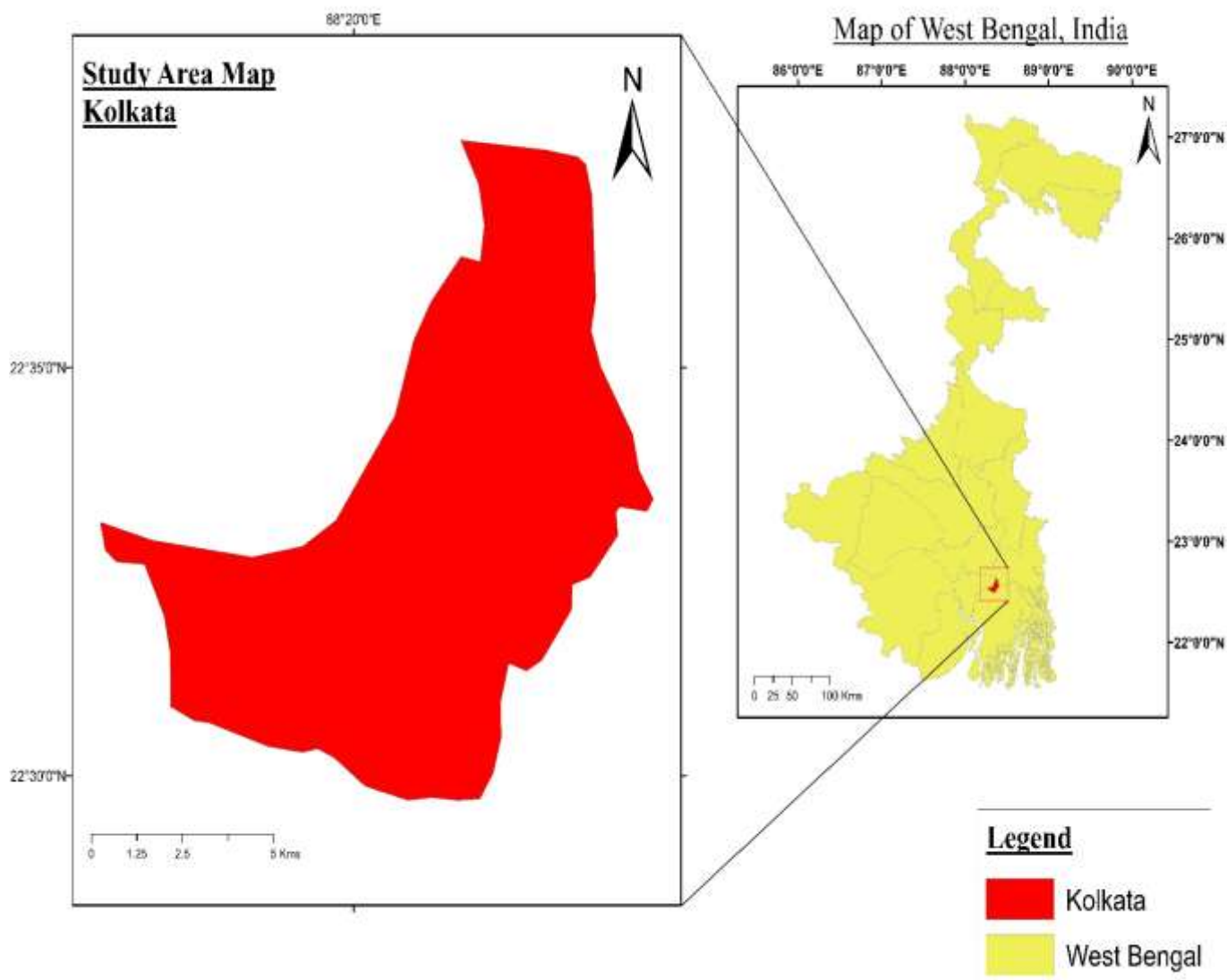
Several studies in India or other developing countries primarily sought to identify deficiencies related to road infrastructure, land use, and traffic operations.

This uneven focus may hamper pedestrian crash prevention efforts. Thus, it is necessary to recognize the key risk factors related to:

- (a) traffic exposure and operational factors, roadway factors and road infrastructure, and different types of land use,
- (b) pedestrian road-crossing behaviour and risk perceptions, and
- (c) spatial features of the road network in the context of an urban setup in a developing country.

Study Area

The study area for the road accident study covers 15 Kilometres of roads. It includes only urban areas that fall under KMC (Kolkata Municipal Corporation). The areas covered under the study area are:



Source: Diva GIS

Methodology

i. Crash Notification

Every Morning Traffic Control Room (TCR) notifies of all fatal and injury crashes on Kolkata Traffic Police Website in the Study Area. On receiving the notification, researchers evaluate the data provided in the notification based on selection criteria, decide on the list of crashes that can be scientifically taken up for investigation including

1. At least one motorized vehicle and
2. Crash Location has to be a public road within the study area.

Other Details such as crash spot has to be identifiable by knowing the final positions, vehicle types and other evidence.

The engineering initiative has resulted in better and more CCTV cameras being used. Breathalysers have been introduced in a big way to check drunk driving. Electronic guns are being used to check over-speeding. Vehicle speed is being played back to drivers through roadside digital electronic displays. As a result, a great deal of digital traffic data is being captured today, enabling analysis and learning. This helps identify accident blackspots and engineering specific solutions for them.

ii. Scene Examination

In the investigation of road accidents involving vehicles, physical evidences play a very important role. Their nature therefore needs to be understood properly before they (Physical evidences) are collected. They should be carefully observed, located and thoroughly documented by means of making notes, sketches and photographs, and then collected.

The major sources of the evidentiary material are as follows:

The Crime Scene

The following evidentiary material can be found at the crime scene:

- The vehicle – may be one or more, its type, direction and position.
- Track marks like tyre impressions of the four wheels, which are found either at sharp turns or where the vehicle has been reversed.
- Broken or damaged parts of the vehicle, greases and lubricants, glass pieces of various shapes and sizes, paint chips or smears etc.

The Victim

1. Injuries.
2. Blood, fibres, hair and skin for control samples.
3. Alcohol and narcotics in the body, if the victim had taken the same.

Vehicle Examination

The condition of Vehicle is important on accident spot.

- is this vehicle itself ?
- Can anything be used to deduce the impact speed?

Speed

Most of the fatal accidents occur due to over speeding. It is a natural psyche of humans to excel. If given a chance man is sure to achieve infinity in speed. But when we are sharing the road with other users we will always remain behind some or other vehicle. Increase in speed multiplies the risk of accident and severity of injury during accident. Faster vehicles are more prone to accident than the slower one and the severity of accident will also be more in case of faster the severity of accident will also be more in case of faster vehicles. Higher the speed, greater the risk. At high speed the vehicle needs greater distance to stop i.e. braking distance. A slower vehicle comes to halt immediately while faster one takes long way to stop and also skids a long distance due to law of motion. A vehicle moving on high speed will have greater impact during the crash and hence will cause more injuries. The ability to judge the forthcoming events also gets reduced while driving at faster speed which causes error in judgment and finally a crash.



Such accidents are usually caused by driving too fast or either one or combination of the following reasons:

- The ability of the driver
- The performance of the vehicle
- The condition of the road

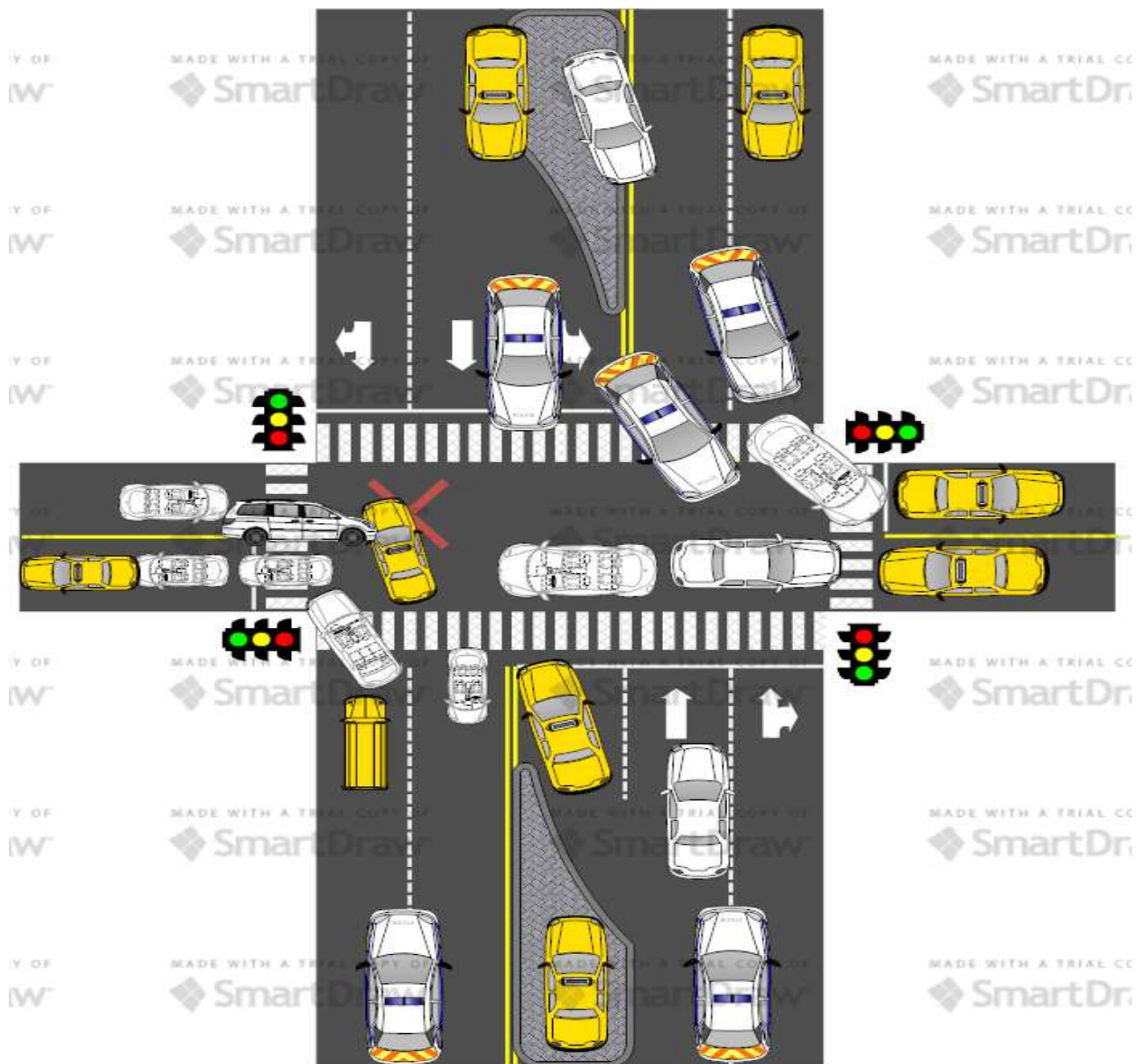
The speed can be calculated by the following methods:

- From the length of skid marks
- From the radius of curved scuffmarks
- From the extent of vehicle damage

Crash Reconstruction

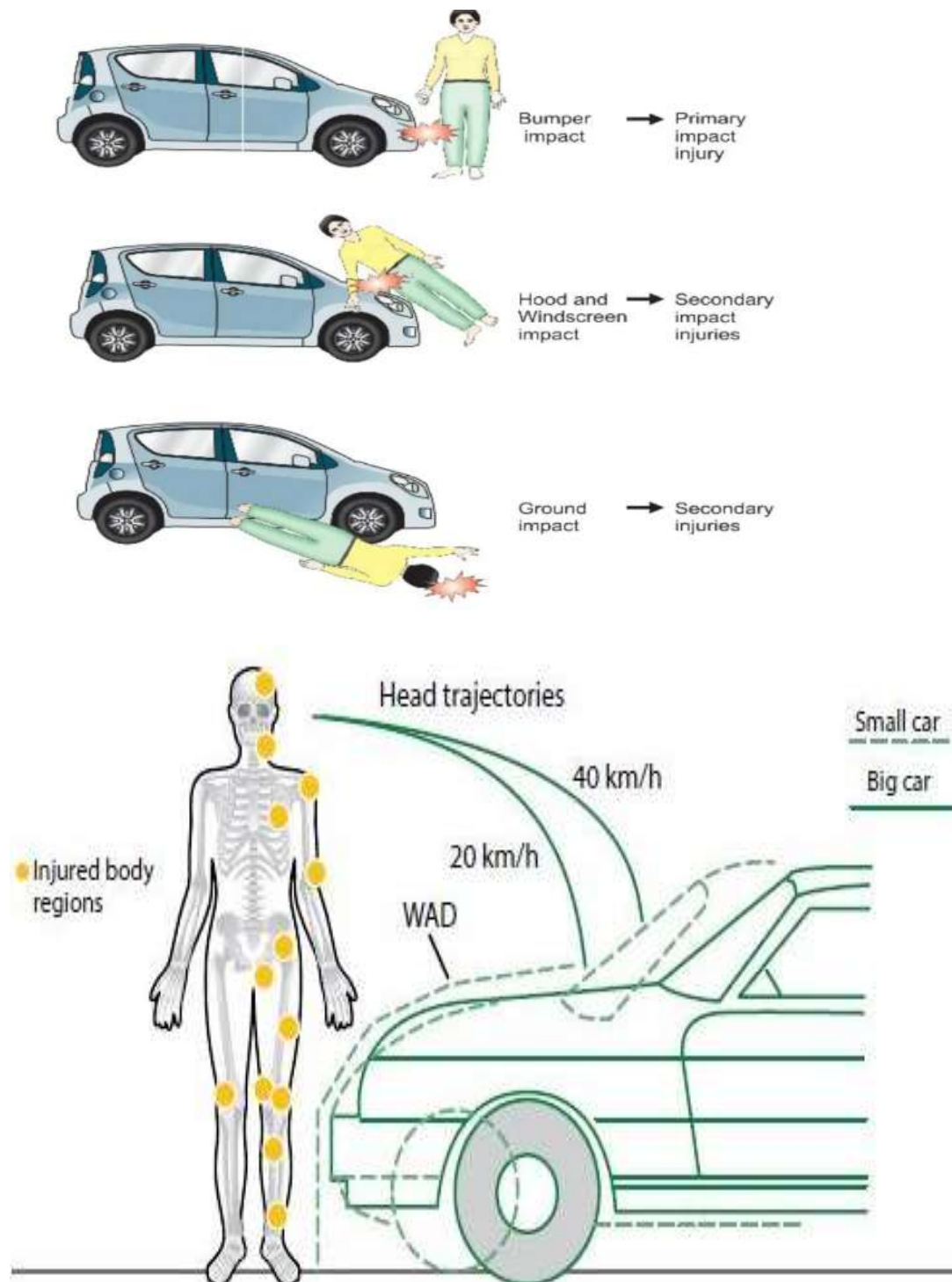
The number of deaths from road traffic accidents across the eastern city of Kolkata in India was 294 in 2018. Of this number, the share of pedestrian deaths stood at about 49 percent. The objective of the Crash Reconstruction Unit is to conduct in-depth investigations and analyses of major traffic collisions. Investigations include the reconstruction of a crash and a study of the factors that may have contributed to that crash. These factors include environmental, human and mechanical and are associated with the three phases of a collision, which are pre-crash, at-crash and post-crash. The ultimate objective of the program is the utilization of these identified causation factors to prevent collisions of a similar nature from recurring.

Based on the obtained evidence and information, Newtonian laws are employed to obtain the speed of the vehicle at the point of impact. In the absence of reliable evidence on the scene or vehicles, CCTV footage is used to calculate the speed.



Injury Analysis

Human thoracic dynamic responses and injuries associated with frontal impact, side impact, and belt loading were investigated and predicted using a complete human body finite element model for an average adult male. That includes details of the head, neck, ribcage, abdomen, thoracic and lumbar spine, internal organs of the chest and abdomen, pelvis, and the upper and lower extremities. The present study is focused on the dynamic response and injuries of the thorax.

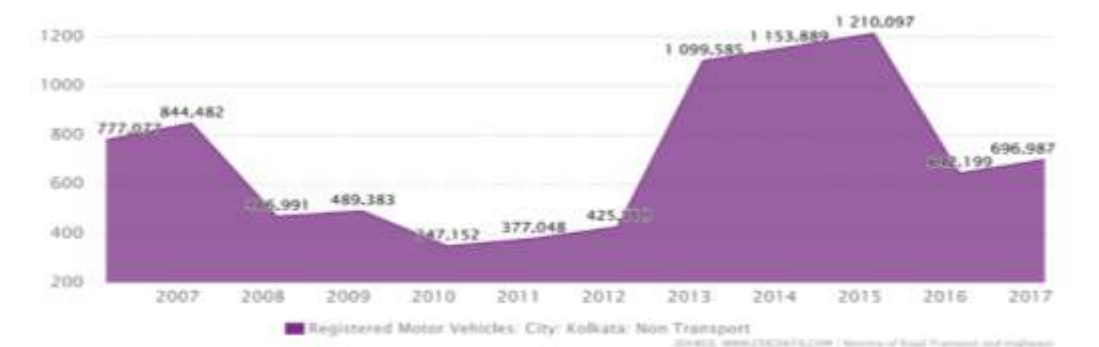


Data Analysis

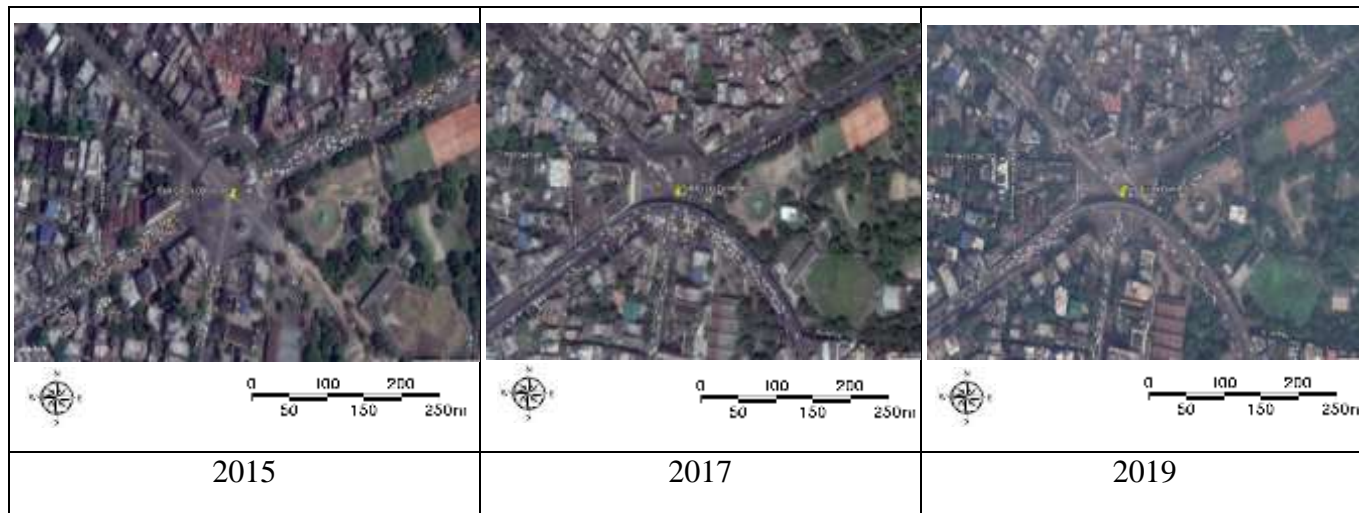
Year	Location	Total Cases	Fatal Crashes	Serious Injury	Minor Injury	No Injury
2015	EM Bypass	6	2	3	2	0
2016		4	1	1	2	0
2017		7	3	2	2	0
2018		5	2	1	2	0
2019		7	1	2	4	0
2020		10	3	3	4	0
2015	Ultadanga Hudco More	0	0	0	0	0
2016		3	3	2	4	0
2017		1	1	0	1	0
2018		1	1	1	0	0
2019		0	0	0	0	0
2020		2	2	2	0	0

Vehicle Registration Every Year

Registration of vehicles, a key indicator of economic health. Non-Transport data is updated yearly, averaging 705.085 Unit from March 2002 to 2017, with 16 observation. The data reached an all – time high of 1,210.097 Unit in 2015 and a record low of 347.152 Unit. In 2017 car data was reported at 353.373 Unit in 2017. These records increase from the previous number of 327.388 Unit for 2016. In 2019, the city of Kolkata in the eastern part of India had around 933 thousand registered two-wheelers. In that year the total number of registered vehicles across the city was over 1.82 million vehicles. There was a considerable rise in the passenger vehicle segment that year.



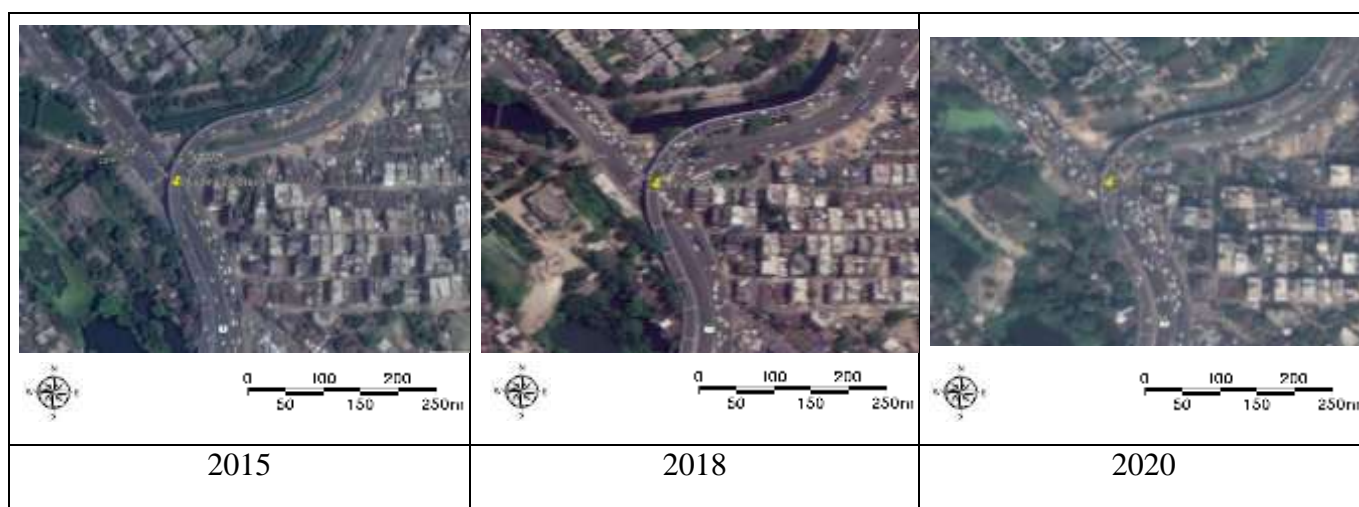
Park circus Connector



Science City Crossing



Chingrihata Crossing

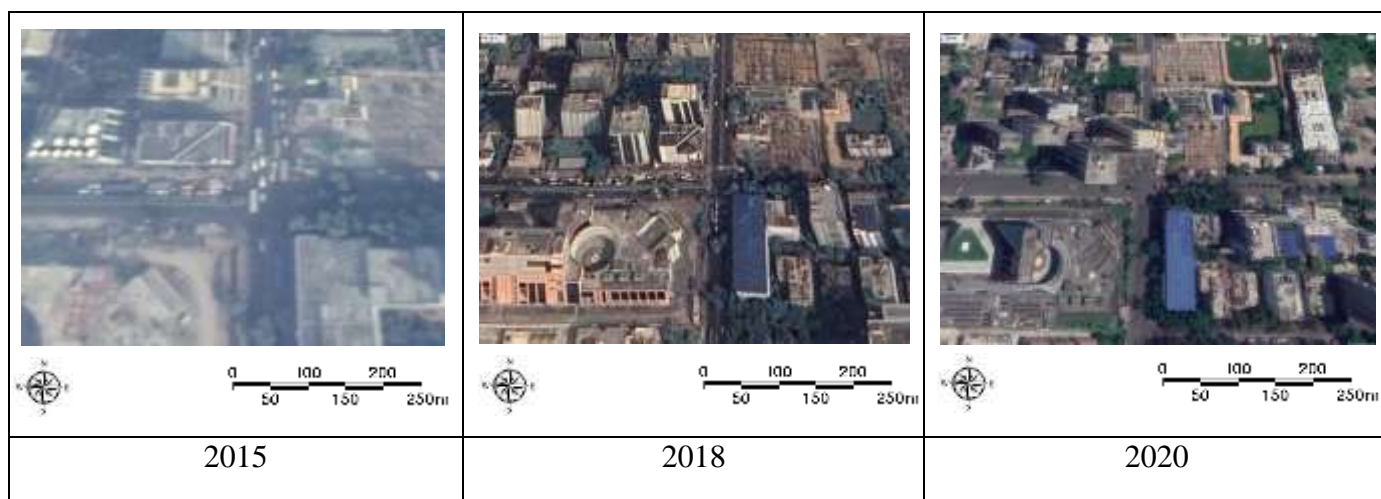


All Image Sources are from Google Earth Pro

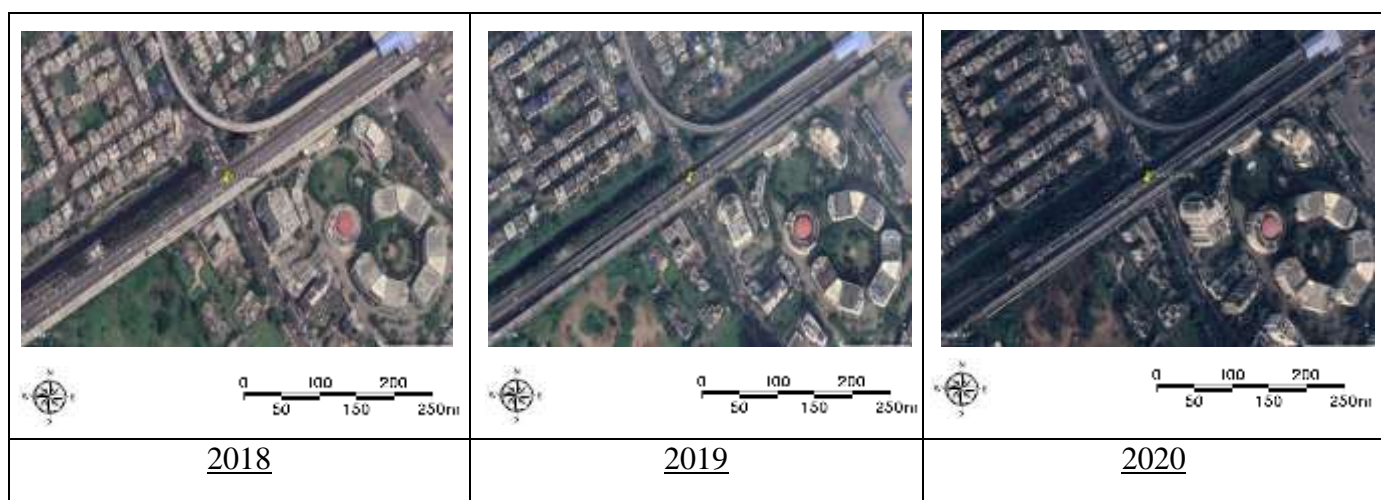
Beliaghata Building More



College More






Wipro Crossing



All Image Sources are from Google Earth Pro

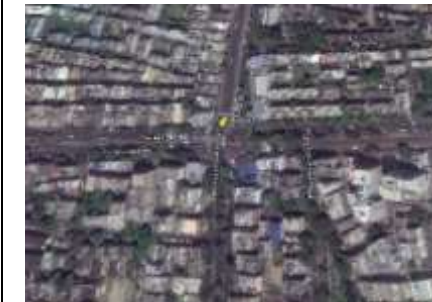

Ultadanga Hudco More

		
2016	2017	2019

Laketown Crossing

		
2015	2018	2020

Kakurgachi Crossing

		
2016	2017	2019

All Image Sources are from Google Earth Pro

Crash Data Sample Analysis

Bus Accident

Crash Date : 03 Jan 2015	Crash Time : 5.38 Pm
GPS : 22°33'7.07"N, 88°24'17.64"E	Crash Location : EM Bypass
Injury Severity : 1 Dead, 25 Injured	Road Structure : Signalized Intersection

Crash Summary

A private bus racing another on EM Bypass today overturned after hitting a guard rail, crushing a cyclist to death, injuring 10 passengers and highlighting the dangers of rash driving on a stretch narrowed by Metro Railway construction. The bus, headed towards Ultadanga, started speeding after the driver spotted another bus on the same Baruipur-Barasat route in front of it near Science City. The driver picked up speed after crossing Science City. The bus was zigzagging along the road and overturned and fell on the service road off the Bypass after overtaking the other bus and hitting the guard rail in front of Silver Spring. After overtaking the bus, our driver veered to the left to pick up passengers and lost control.



Source: Google Maps



Image Source: The Times of India

Car Accident

Crash Date : 07 Sep 2020	Crash Time : 8.45 PM
GPS : 22°27'54.39"N, 88°23'36.21"E	Crash Location : EM Bypass
Injury Severity : 1 person was seriously injured	Road Structure : One Way Traffic

Crash Summary

A car going through the road EM bypass, unfortunately the brake of the car did not work. The driver lost his control from the car. The car hits the divider of the two one way and the car get crashed and fall over the divider to the opposite way.



Source: Google Maps



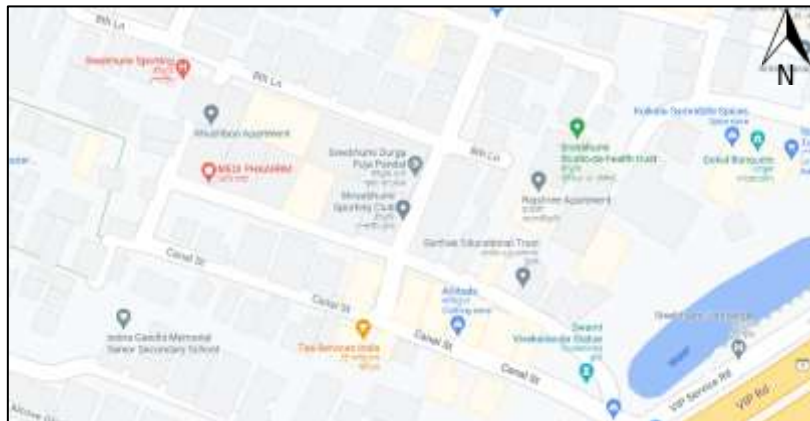
Image Source: ABP Ananda

Car Accident

Crash Date : 30 June 2021	Crash Time : 10:34 AM
GPS : 22°36'1.36"N 88°24'24.23"E	Crash Location : Lake Town
Injury Severity : 0 Dead, 1 Injured	Road Structure : Signalized Intersection

Crash Summary

Accident near Sreebhumii in Laketown. The car overturned after hitting the divider. The accident took place on VIP Road around 5 in the morning. On the way from Laketown to Ultdanga, the car overturned after hitting a divider. Witnesses said four occupants, including the driver, fled. Police have arrested one passenger. How the four occupants, including the driver of the vehicle, escaped in the accident is being investigated.



Source: Google Maps



Image Source: ABP Ananda

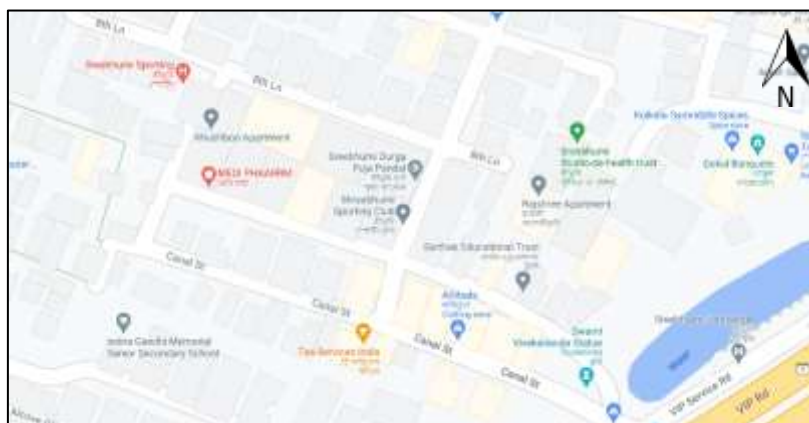
Bike Accident

Crash Date : 23 Oct 2019	Crash Time : 12:55 AM
GPS : 22°36'1.36"N 88°24'24.23"E	Crash Location : Lake Town
Injury Severity : 2 Dead, 0 Injured	Road Structure : Signalized Intersection

Crash Summary

Imran Kamal, 38, and his wife Sabina Alam, 32, residents of Ahiri Pukur Road in Karaya, were wearing helmets when the accident occurred minutes past midnight. “They were flung into the air on impact and run over by the trailer truck moving in the same direction as they landed on the road,” an officer of South Port police station said. “The trailer truck had fled by the time we reached the spot. Their helmets were intact.

They were declared dead at SSKM Hospital.



Source: Google Maps



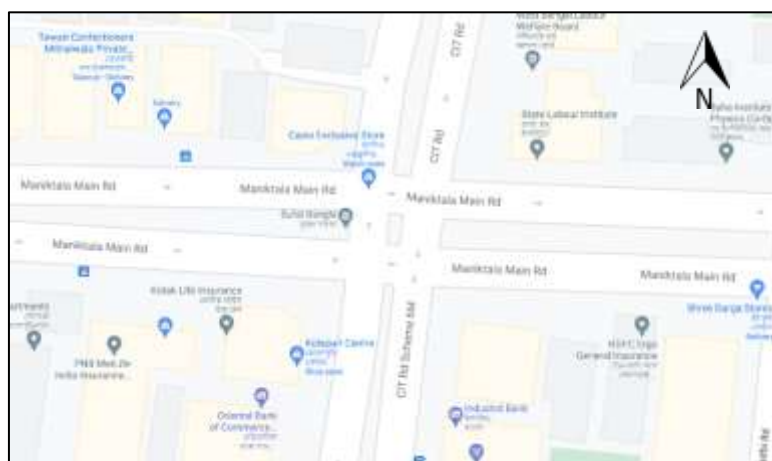
Image Source: ABP Ananda

Bike Accident

Crash Date : 5 Nov 2019	Crash Time : 10:40 AM
GPS : 22°34'49.06"N, 88°23'25.79"E	Crash Location : Kakurgachi
Injury Severity : 1 Dead, 0 Injured	Road Structure : Signalized Intersection

Crash Summary

1 Woman died in a road accident in Kankurgachi The accident took place near Kankurgachhi crossing on Tuesday The couple was riding a bike Accident 6 when the bike slipped on the tramline The bus coming from behind crushed the couple The woman died on the spot Seriously injured husband admitted to hospital.



Source: Google Maps



Image Source: ABP Ananda

Bus Accident

Crash Date : 03 Feb 2018	Crash Time : 11.00 AM
GPS : 22°33'27.73"N, 88°24'42.57"E	Crash Location : Chingrighata Crossing
Injury Severity : 2 Dead under the bus wheel	Road Structure : 3 head road with fly over

Crash Summary

A bus turning the road from Ultadanga to sector 5, in this turning point two collage students are also crossing the road with cycle, then the accident was happened.



Source: Google Maps



Image Source: ABP Ananda

Bus Accident

Crash Date : 02 Nov 2017	Crash Time : 10.30 AM
GPS : 22°33'43.17"N, 88°24'30.00"E	Crash Location : Beliaghata Building more
Injury Severity : 1 Dead and 1 seriously injured	Road Structure : 3 head road

Crash Summary

The father was out to drop his daughter to school on his bicycle. Sweta was seated at the front of the cycle. As soon as they cycled onto CIT Road at Belegghata around 10.30 am, a speeding crane employed for East-West Metro Corridor work hit the bicycle.

Both the father and daughter were flung onto the road. The crane's rear wheel crushed over Sweta before the driver could apply the brake. The father was left bleeding on the road due to the thrust.

The dead victim Sweta Das's picture has given bellow.



Source: Google Maps



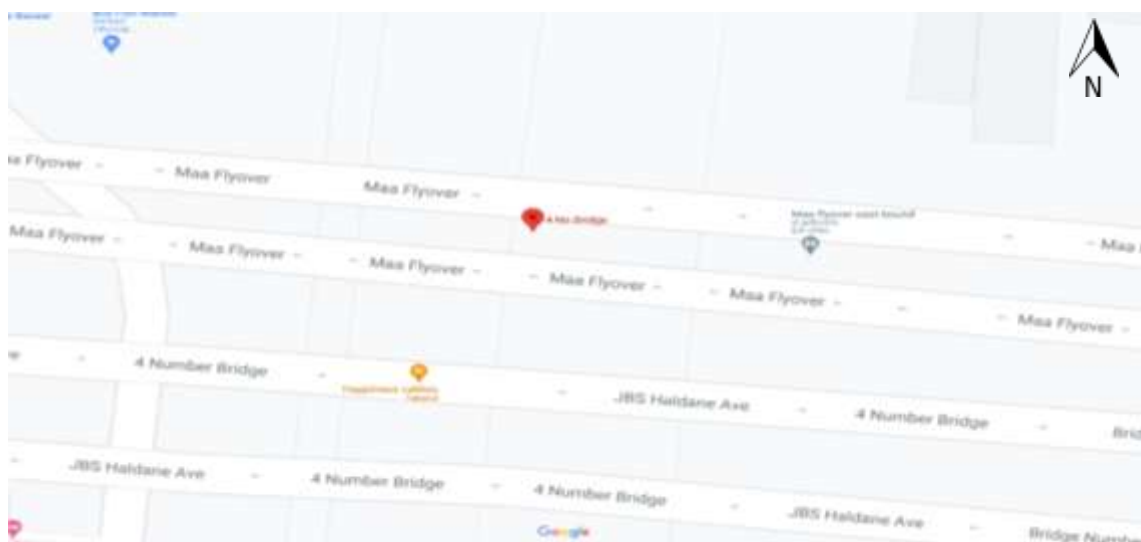
Image Source: ABP Ananda

Bike Accident

Crash Date: 01 Jan 2018	Crash Time: 8.45 A.M.
GPS: 22°32'35.65"N 88°21'58.11"E	Crash Location: Park Circus 4No. Bridge
Injury Severity: 1 biker died on spot	Road Structure: One Way Traffic

Crash Summary

A biker aged 16 died on spot, as his leg entangled with the wires fallen all across the bridge. As told by the eye-witnesses, the boy had been over-speeding and hence he couldn't see the wires fallen across the road and got entangled in it. Due to this over-speeding, he got off his bike and fell hard across the road thereby dying on the spot.



Source: Google Maps



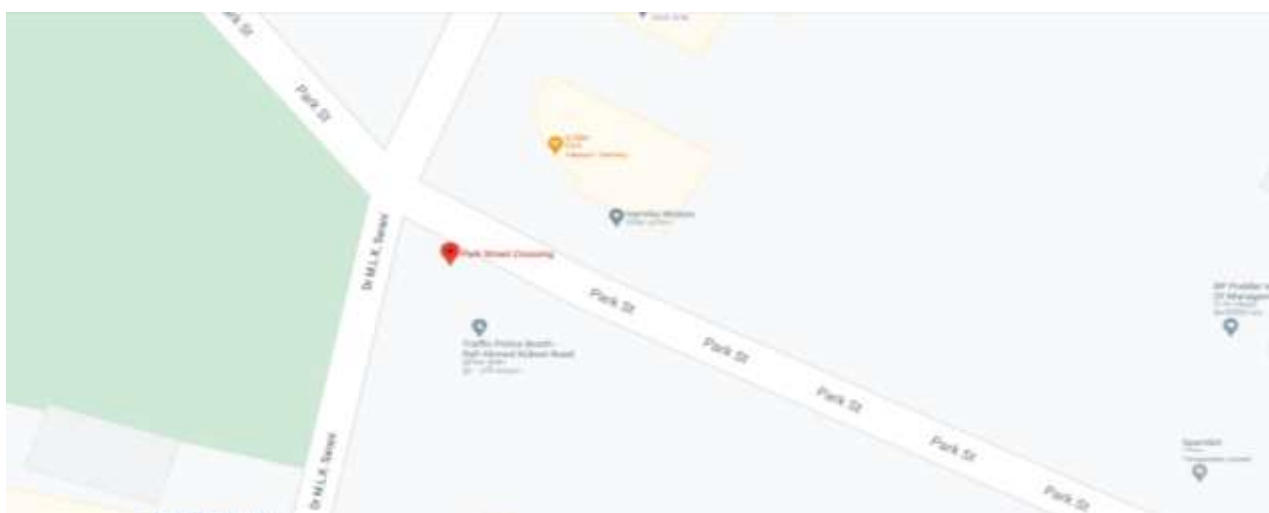
Image Source: ABP Ananda

Bike Accident:

Crash Date: 18 Oct 2016	Crash Time: 10.25 A.M.
GPS: 22°32'35.65"N 88°21'58.11"E	Crash Location: Park Circus Crossing
Injury Severity: 1 severely injured	Road Structure: Two Way Traffic

Crash Summary:

A small goods carriage van collided with the road divider. The driver of the vehicle is severely injured. He was rushed to the nearby hospital. As reported that suddenly the vehicle lost control and dumped into the side railing of the divider.



Source: Google Maps



Image Source: ABP Ananda

Black Spot Analysis

Black spots which are short stretches where the accidents /fatalities take place repeatedly get created on the road network due to various reasons like

Commissions & omissions in the development projects

Changes in the road side environment

Changes in developmental scenario in the region

Unplanned developments /unauthorized constructions on/ near the roads like advertisement boards, Poles, statues, buildings, trees, bushes etc.

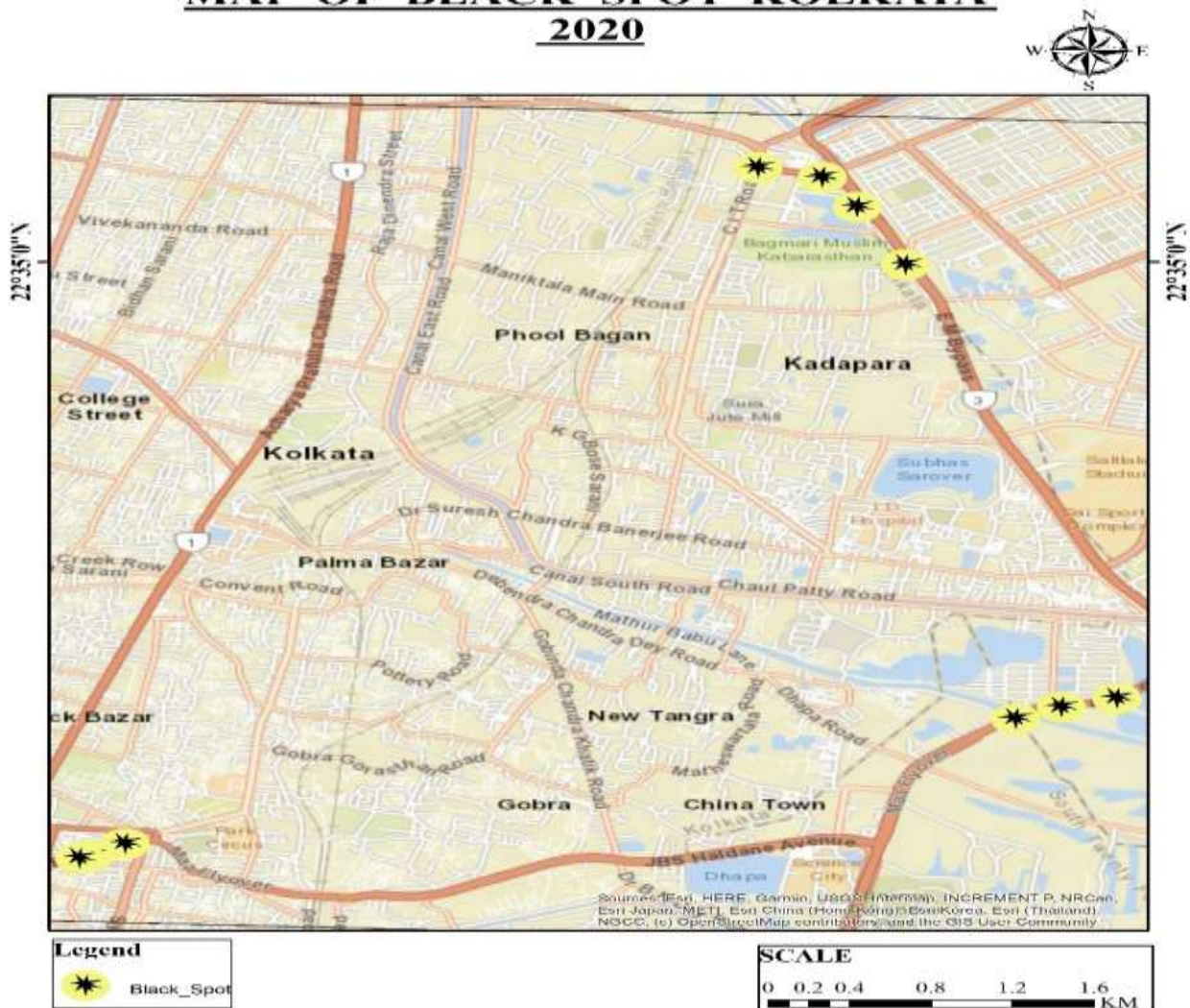
- Therefore, rectifying the black spots is a continuous process.

Road accident black spot is literally not a spot but is a short stretch of road of about 500 m length

Where Five accidents involving serious injuries/fatalities or Ten fatalities took place during the past 3 calendar years.

Sometimes single accident can have multiple fatalities. Hence number of fatal/ grievous accidents at the same location is better indicator of problematic road / road environment (i.e., Black spot) than the number of fatalities.

MAP OF BLACK SPOT KOLKATA 2020



Source: Arc Map

Role Of GIS & Remote Sensing

GISs can provide many more analytical capabilities than other mapping tools. For example, while a GIS is a database that contains geographic information, it is also an intelligent mapping system that can link features with other features and an information transformation tool that can create new geo-databases based on existing ones by applying analytic functions. With stored spatial (geographic) data, GISs enable spatial display, spatial integration, spatial query, spatial analysis and processing, etc., almost all of which have applications in transportation studies, especially in traffic accident analysis.

Traffic accidents can be shown at their locations of occurrence on digital maps. At least three methods are used to accurately locate traffic accidents on maps. The selection of the method depends on the recorded location data.

- The exact location of accident is important as an accident can display spatially only if the XY coordinator known.
- Geocoding addresses can come from the exact addresses only. This approach normally applies to the two format types of traffic accident addresses that were recorded on traffic accident reports. One is the exact address. The other format is an intersection of two streets. Both of these address formats can be recognized and added to the correct locations if the correct address locator manager is selected. However, this method requires the input of a reference layer, which stores all the geographic information and attributes of each road section.
- Analysis overtime can observe the exact location of UTA on road transportation network with qualification and characteristics of that specific location. This method requires a route layer, which includes linear features that store unique identifiers and measurement systems. The traffic accident data should be stored with an attribute indicating the route name and an attribute indicating the measurement. With the development of computer science and GIS techniques, numerous researchers have used GISs for displaying UTAs on a digital map and doing spatial analysis, GIS is the most appropriate technology.

Conclusions

A traffic accident is the event with multiple associated factors which include but are not limited to human act and behavior, urban structure, culture, etc.

The associate factors underlying traffic accidents are usually different and interdependent. GISs represent unique spatial methodologies which provide answers to questions about the complex causation of traffic accidents. Such systems can be effective for integrating and analyzing physical, social, and cultural environments. GIS technology offers many advantages related to data integration, interactive querying of databases and design, and presentation of findings in the form of maps. Both the visual impact and the data analysis provided by GISs are advantages that support their use. The ability to overlay data layers allows interpretation beyond that available when using traditional research and statistical methods.

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