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LOCATING ACCIDENT PRONE LOCATIONS FOR NON MOTORISED ROAD USER USING GIS

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Abstract

Walking is the most sustainable and most use mode of transportation in Indian cities. In 2012-13, an estimated 520 accidents in non-motorized (38% of the total road accidents) occurred in Vadodara. The objective of this study is to investigate the potential of utilizing geographic information system (GIS) in identifying pedestrian accident prone locations. Crash data were geocoded in ArcGIS over the digitized road map of Vadodara. Results highlighted non-motorized accident prone locations in Vadodara.

Keywords- *Road Accident; Pedestrain; Kernel Density; Non Motorised; Bicyclist.*

I. INTRODUCTION

Roadways are the strength of any country, acting as indicator for the economic development of the country. Such that, the transportation plays a very projecting role in developing countries like India. Apart from the satisfying the travel demand, its effective process reduces the number of problems in many aspects. The successful in trade, commerce and industry depends directly on the growth of roadways of the country. More the length of roadways, the wealth is more of the nation. But these facilities of roadways is increasing the population of vehicles and there by resulting in increasing number of traffic congestion and accidental fatalities. The accidents occurring on the roads are our national concern here and it will be discussed in detail.

Road accidents have grown up in the recent years due to some reasons, so safety of road transport needs prime attention as it results in heavy damages and loss of life. A complete realization of the problem and many factors, which contribute to the accident, is required before effective preventive measures can be used to improve the present problem. Unfortunately, the first growth of road transport is associated with steep rise in a number of traffic accidents resulting in to the loss of human lives. The loss to the nation due to the ever-increasing accidents is countless, eating into the economics of the nation, to a larger chunk. The loss is directly proportional to the increase in the vehicle population. The term “safety” implies that no accidents are acceptable. However, accidents do happen and are caused due to the presence of several accident contributing/ responsible factors. Too often, road safety is treated as a transportation issue, not a public health issue, and road traffic injuries are called accidents, though most could be prevented. As a result many countries put far less effort into understanding and preventing road traffic injuries than they do into understanding and preventing diseases that do less harm.

A sustainable transport system must provide flexibility and accessibility to all urban residents in a safe & environment friendly mode of transport. This is a complex and difficult task when the needs and demands of people going to different income groups are not only different but also often conflicting. India is experiencing a new phenomenon in road traffic patterns and crashes for which there is little preference in the highly motorized countries. Here the same road space gets used by modern cars and buses, along with locally developed vehicles for public transport, scooters & motorcycles, bicycles, rickshaws, and animal & human drawn carts.

The infrastructure design based on homogeneous traffic models, has failed to fulfill the mobility and safety needs of this mixed traffic. We show that pedestrians, bicyclists and non-motorized rickshaws are the most critical elements in mixed traffic.

II. NEED OF STUDY

Rapid economic development in many low and middle-income countries has led to increased motorization. Since 2007, there has been a 15% worldwide increase in the number of motorized vehicles. Globally, there are now more than 1.6 billion registered vehicles – 47% of which are in high-income countries, 52% in middle income countries and 1% in low-income countries. Middle-income countries are motorizing most rapidly and now have more than half of the worlds registered vehicles, compared with 39% just three years ago. With increases in motorization, governments must balance their desire for increasing flexibility with ensuring the safety of road users inside –as well as outside – motorized vehicles.

The increasing number of motorized vehicles makes roads more dangerous for those road users who use alternative modes of transport – notably those who walk, cycle. In planning road construction projects, there has been insufficient attention given to preventing the negative effects of motorization from falling most heavily on these road users most at risk. For example, new multi-lane roads are often built to cut through communities without provision of safe routes and crossings for pedestrians, slowing traffic speeds, or dedicated lanes for cyclists.

Policies to encourage walking and cycling need additional criteria to ensure the safety of these road users. Encouraging children to walk to school without providing pavements or safe places to cross the road, or reducing the speed of traffic, could in fact lead to increased injuries. Promoting city cycling to reduce congestion cannot be encouraged if cyclists repeatedly find that their lanes cut across oncoming traffic. Measures to separate walkers and cyclists from other road users in conjunction with speed management interferences are particularly important if such policies are to be successful.

There has been some progress in applying national or subnational policies to promote walking and cycling, with 68 countries having such policies (compared to 57 in 2008). However, only 79 countries have policies to protect vulnerable road users by physically separating them from high-speed road users. As a result, many countries attempting to encourage walking and cycling as viable alternatives to motorized transport do not have infrastructure policies in place to ensure that walking and cycling are safe, and could potentially increase risks for road traffic injuries.

Countries that can effectively reduce private motorized vehicle should increase the appeal of walking and cycling make associated infrastructure improvements to protect pedestrians and cyclists in order to reduce the risk of road traffic injuries. Additional co- benefits can also result from such policies, including reduced air pollution and greenhouse gas emissions, reductions in traffic congestion, and beneficial health outcomes associated with increased physical activity from walking and cycling.

In road traffic, the risk is a function of four elements: exposure, the probability of a crash, the probability of injury and the outcome of the injury. Compared to other road users, the pedestrian is particularly exposed to injury as they are not protected by vehicle shell. Moreover the behavior and mix of the traffic and speed creates even more dangerous conflicts among the different road users. Vehicle factors such as braking, driving and maintenance as well as defeats in road design and lack of traffic separation can also lead to high pedestrian risks conditions. In case of road crash, if appropriate pre hospital and emergency care is not provided, the result of injuries will be more several and more lives will be lost. There is tremendous need of research work in the field of pedestrian risk assessment with a special attention to urban road users who are more subjected to these conditions.

All types of road users are at risk of being injure or killed in a road traffic crash, there are notable differences in fatality rates between different road users groups. In particular, the road users like pedestrians are at greater risk than vehicle occupants and usually bear the greatest burden of injury. The pedestrians and cyclist tend to account for a much greater proportion of road traffic deaths in low income and middle income countries, than high income countries. Identifying accident prone locations for road traffic accidents are important for the appropriate allocations of resources for safety improvements. This study therefore concentrates on the traffic safety aspects by locating accident prone locations for Vadodara using GIS.

III. OBJECTIVE

- To identify accident prone locations within Vadodara city.
- To understand the causes of road traffic accidents.

IV. STUDY AREA

Vadodara is one of the historical cities of India and it is located on 22° 18° 00°° N 73° 12° 01°° E. Vadodara city recalls about the old Gaikwad emperor. Vadodara is the third largest city of Gujarat and the eighteenth largest city of India. It is situated on banks of river Vishwamitri. It has an area of 148.95 km^2 and urban population of 1.6 million (Census 2011). Vadodara city has population density of 11 190 people/km^2 and is one of the corporations of Gujarat state. It is junction between Mumbai to Delhi and Ahmadabad to Delhi and Mumbai. (RITES 2011). It has also airlines connecting major cities. It is known as 'cultural city' and it has reputation as education hub and chemical hub of Gujarat. Vadodara city is very near to oil and gas fields. The Gujarat Refinery is situated in the vicinity of Vadodara. Vadodara could be called as the center of Indian Pharmaceuticals, Chemical and Electronic Industries. Vadodara has 1680km paved and 400 km of unpaved roads. All facility available in Vadodara city makes it most livable and lovable city.

V. BASIC CONCEPT

The term Geographical Information System (GIS) is applied to system that perform the computational treatment of geographical data and that store the geometry and the attributes of data are dereference. A Geographic Information System (GIS) is a computer system for capturing, storing, querying, analyzing and displaying geographic data. A GIS can be effectively used to identify accident black spots on roads. The results can be displayed graphically with the help of GIS which can be used for planning and decision making.

DENSITY TOOL

- Line Density: Calculates a magnitude per unit area from polyline features that fall within a radius around each cell.
- Point density: Calculates a magnitude per unit area from point features that fall within a neighborhood around each cell.
- Kernel Density: Calculates a magnitude per unit area from point or polyline features using a kernel function to fit a smoothly tapered surface to each point or polyline.

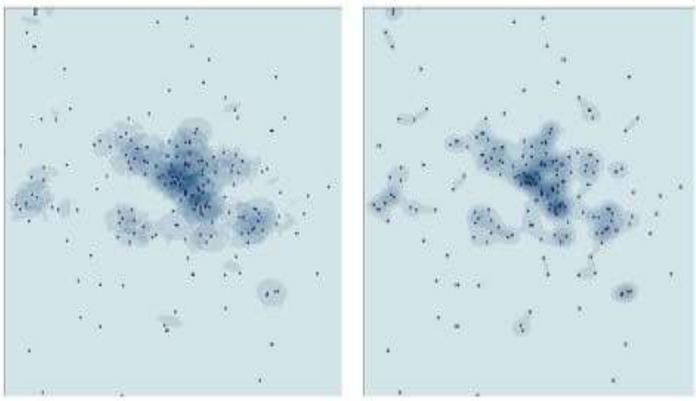

Figure 1 : Point density & kernel density

VI. METHODOLOGY

The accidents reports of different areas of Vadodara city are provided by local police stations called first investigation report. The FIRs were collected by personal visits to police stations of different areas. The digital map of Vadodara city was imported in the data frame of the Arc Map window and saved as "roads" layer and before starting the editing, the imported digital map and the data need to have the common 'project co-ordinate' system so as to make their scales the same. Excel sheet with accident details given by police was imported in GIS by giving X and Y coordinates of each accident (consider all as points) by searching the accident locations in Google map. For every point marked, a feature identity is created automatically on GIS, which is whole number. After importing the 2012 year accident data as points, the file was saved as a layer. After that using Arc Toolbox with the help of Spatial Analyst Tools found the Kernel Density for all road traffic accidents, all pedestrian accidents and different types of accidents, the file was saved as a layer.

VII. ANALYSIS & RESULT

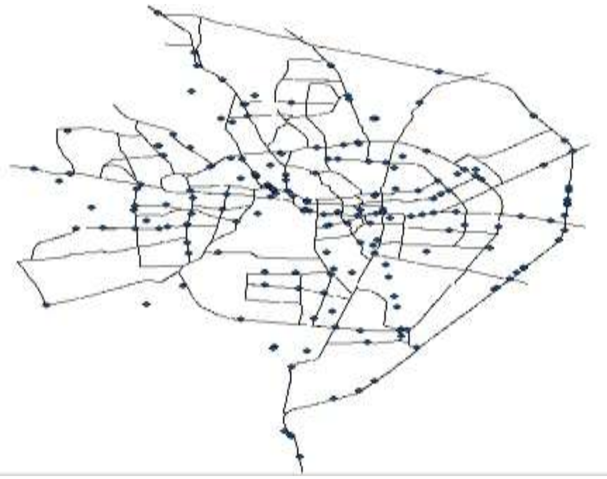

Figure 2: Location of all pedestrain accidents

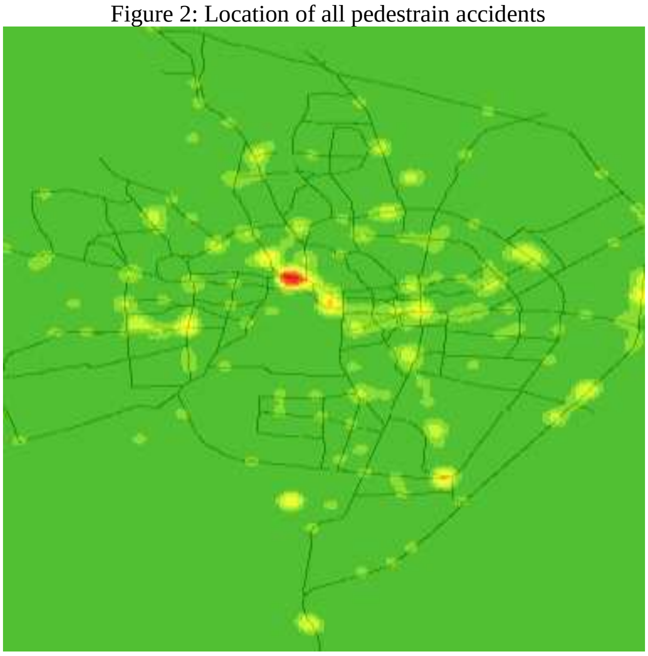

Figure 3: Kernel density for all pedestrian accidents

Figure 4: Locations of bicyclist accidents

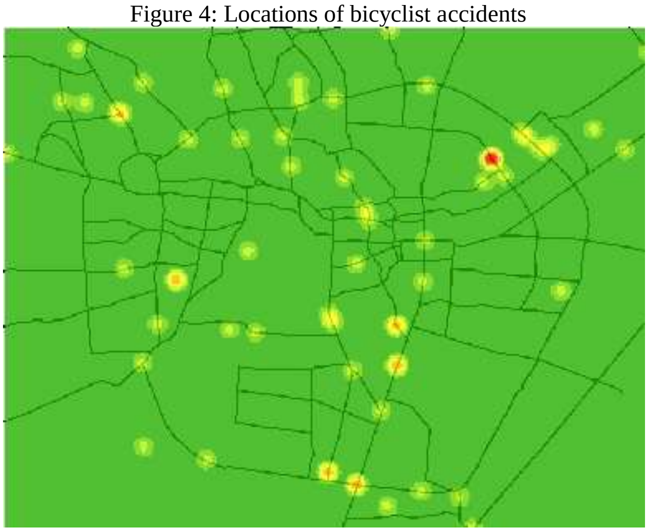

Figure 5: Kernel density for bicyclist accidents

The geographic distribution of all accidents locations indicates accidents density is higher near to Dumad chowkdi, Waghodiya chowkdi, Kapurai chowkdi and Railway station to Kalaghoda circle for Vadodara city and consisting 18% of the total road traffic accidents. If we select pedestrian as victim then 24% (384) of total accidents occurred in 2012-13 for pedestrian. Pedestrian crash density is higher near Kalaghoda circle, Sayaji hospital and Tarsali ITI, had about 13% of the total pedestrian accidents. Waghodiya chowkdi, Kapurai chowkdi, Jambuva crossing on NH-8 highway and Sama talav circle are highly dense locations for pedestrian fatal crash road accidents which are about 39% of the total fatal pedestrian accidents in Vadodara city. Hot spot for major pedestrian accidents are near railway station, Tarsali ITI, Genda circle and near Kapurai chowkdi had about 14% of the total major pedestrian accidents. Accident crash density is higher near Kalaghoda to Railway station road, Nyay mandir and Mandvi for minor pedestrian accidents had about 18% of the total minor pedestrian accidents. Accident Prone locations for bicyclist accidents are at sindhu sagar varasiya, Shushen circle, near ONGC, near Pratap nagar railway station and Ward office O.P. road had about 21% of the total bicyclist accidents.

VIII. RECOMMENDATIONS

The footpaths were made with the purpose of helping people walk to avoid careless driving and make people to understand and to follow rules there should be CCTV cameras operating in some areas. Junctions must be signalized and periodical check should be applied for its proper working or not. More ever there should be proper signboards and speed breakers too for controlling speed.

IX. CONCLUSION

GIS effectively helps in the visualization of problem of road accidents and processing of accident data for performing complex spatial analysis. It is for one year 2012 year road traffic accidents data. The total road traffic accidents in Vadodara city in 2012-13 was 1369 consisted of around 616 minor accidents (45% of total road traffic accidents), 561 major accidents (41% of total road traffic accidents) and 192 fatal accidents (14% of total road traffic accidents). In these data 520 non-motorized (38% of the total road traffic accidents) and 849 motorized (62% of the total road traffic accidents).If the X and Y coordinate of locations using GPS were saved in police database then plotting of accidents points would have been easier and results of the analysis more reliable. This study was a preliminary on for identification and investigation of hazardous road location.

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