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# GIS BASED SPATIAL ANALYSIS OF URBAN TRAFFIC ACCIDENTS

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***Abstract— 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 behaviour 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.***

***Key words: GIS, Spatial analysis, black spots, kernel density estimation, traffic accidents.***

## I. INTRODUCTION

Transportation engineers rely heavily on geographic information systems. While there is a certain comfort from having a record system containing large numbers of paper maps with highways data marked on them, such systems have serious disadvantages and hidden costs. In any desired combination and at any scale. Identification of problem locations is one of the most important aspects of accident studies. There is a need for better information on the circumstances of collisions, especially with regard to location in order to come up with a general picture of the data. A prototype Geographic Information System and Road Accident View System (GIS-RAVS) was developed for the purpose of reducing the number of accidents. The client can distinguish high mishap area, acquire the mischance area's positioning, picture the street mischance and area data, input and recover the mishap database, perform measurable investigation on the chose mishap area et cetera inside a brief period. The main investigation is hub examination, which is working to show the mishap information and envision a specific region. The second examination is dissemination plot, which can show the in general of the mischance cases moreover, two minor capacities named Web search tool and Mishap Positioning are incorporated. The non random distribution of accidents, both in spot and time, often raises questions about the location and the reasons for that location, so the objective of this study is to determine the factors of accidents at those spots and to take actions that will reduce crash frequency by spatial analysis which creates or extracts different new information from spatial data with Kernel Density Estimation (KDE) using GIS.

## II. SPATIAL ANALYSIS METHOD

Spatial Analysis is the process of checking the locations, attributes, and connection of features in spatial data among overlay and other analytical techniques, which is used for acquiring knowledge that can be used in different aspect. Spatial analysis creates or extracts different new information from spatial data. Different techniques under this category are Kernel Density Estimation (KDE), Point Density, Line Density etc. Piece thickness estimation is a basic information smoothing issue where surmisings about the populace are made, in view of a limited information test. Part thickness is one of the critical spatial examination instruments in economically accessible GIS programming. K was used to figure thickness of mischances inside an inquiry data transfer capacity of 0.3 km. K divides the entire study area into pre-determined number of cells. It uses a quadratic kernel function to fit a smoothly tapered surface to each accident location as shown in Figure 2 [20]. The surface value reduces from the highest at event location point to zero when it reaches radial distance from event location point. The value of kernel function is assigned to every cell as individual cell values. The resultant density of every cell is computed by adding its individual cell values. To account accident severity, the weight assigned to each accident is represented as its Identification Number (ID). Population field of kernel density function is selected as aforesaid ID. This facilitates counting of each accident according to its weight assigned. In case of no severity, or analysis according to incident points, the population field is selected as "None".

Kernel estimator can be defined as in Equation $f(x) = \frac{3}{nh^2\pi}\sum_{i=1}^{n}\{1 - \frac{1}{h^2}[(x - x_i)^2 + (y - y_i)^2]\}^2$ .....(1)

where: h is termed as bandwidth, radius or smoothing factor; K is kernel and f is estimator of probability density function. The kernel estimator depends upon choice of bandwidth (h), hence appropriate bandwidth should be determined according to purpose of study.

## III. RESEARCH APPROACH

***Study Area:*** Cyberabad comprises of the considerable number of edges and semi urban zones of the Hyderabad. Territories, for example, Madhapur, Kondapur, Gachibowli, Uppal, Medchal and Shamshabad and so on come under Cyberabad. Cyberabad surrounds Hyderabad on all sides.With the aggressive promotion of some areas of Cyberabad, there have been extensive investments in luxurious residential townships, technological infrastructure such as Hitech city and many other IT and ITES companies. Area and Population of Cyberabad is approximately 3600 sq.km and 80 lakh, study area of Hyderabad can be seen in. The area proposed for the study is presented in Figure 1. The objectives of the study is to develop spatial and attribute database for the Traffic information , to classify traffic hurdles in the study area, to find best optimization method of traffic optimization and to identify alternate route to prevent accident. The methodology is presented as shown in Figure 2.

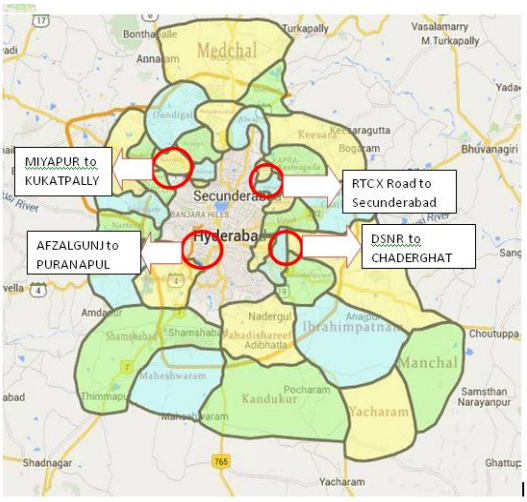


**Figure 1 Study area**

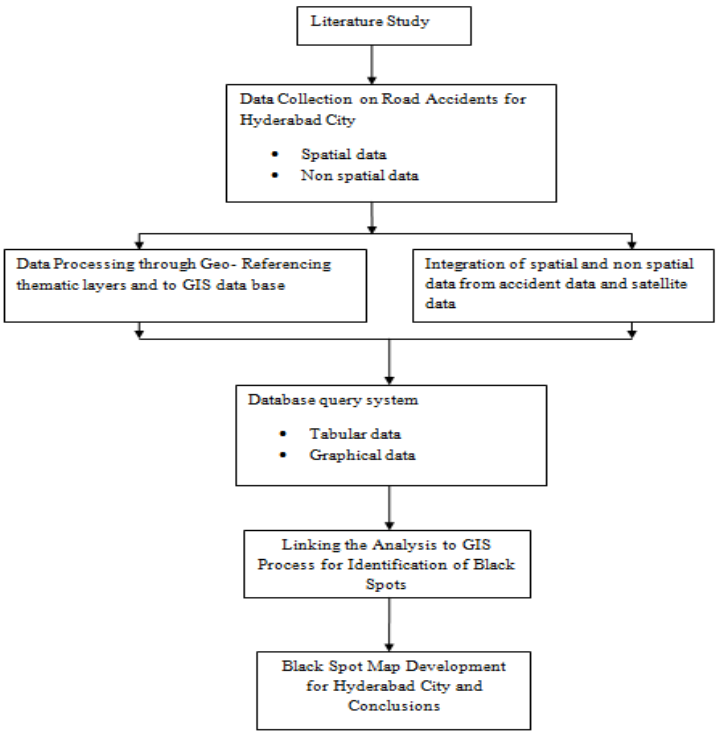


**Figure 2 Research flow chart**

## IV. ANALYSIS

**Step-1:** Open Application for QGIS as GIS application to create data

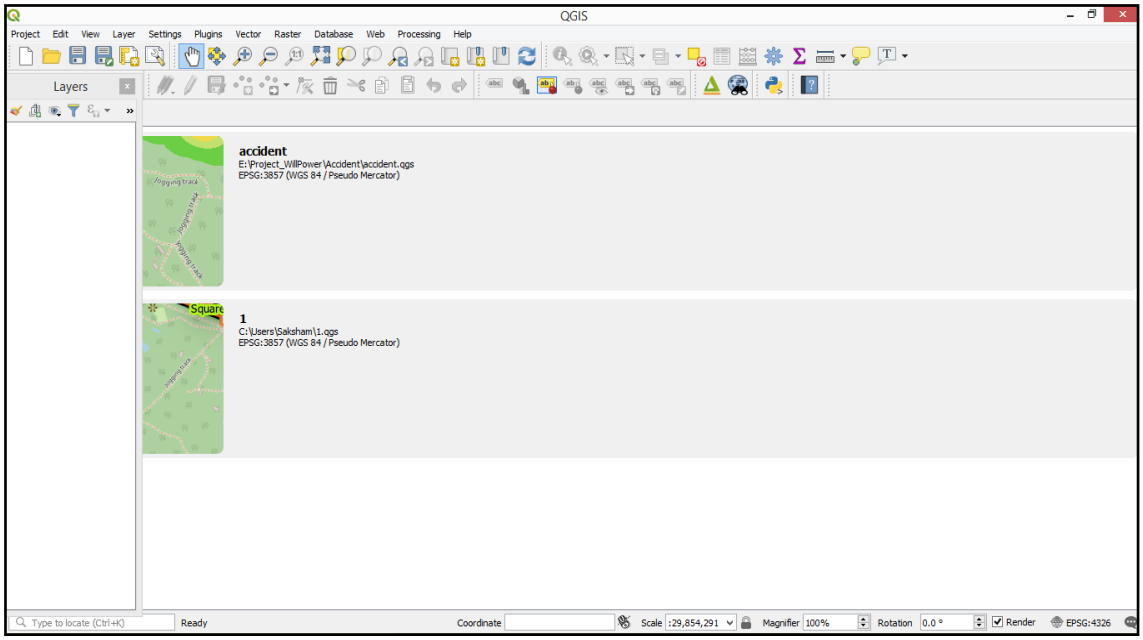


**Figure 3 Open Application**

**Step-2:** Get collected excel or csv file. For example we have Miyapur accident excel file.

| id | X | Y | id | X | Y |
|---|---|---|---|---|---|
| 1 | 8722883.644 | 1978654.418 | 28 | 8723257.12 | 1978721.604 |
| 2 | 8722851.039 | 1978646.513 | 29 | 8723282.808 | 1978712.712 |
| 3 | 8723295.653 | 1978697.891 | 30 | 8723321.342 | 1978696.903 |
| 4 | 8723390.504 | 1978717.652 | 31 | 8723345.054 | 1978710.735 |
| 5 | 8723391.492 | 1978706.783 | 32 | 8723317.39 | 1978720.616 |
| 6 | 8723425.085 | 1978700.855 | 33 | 8723290.713 | 1978718.64 |
| 7 | 8723401.372 | 1978695.915 | 34 | 8723262.06 | 1978703.819 |
| 8 | 8723357.899 | 1978698.879 | 35 | 8722943.914 | 1978666.274 |
| 9 | 8723363.827 | 1978712.712 | 36 | 8722930.081 | 1978668.25 |
| 10 | 8723366.791 | 1978724.568 | 37 | 8722920.201 | 1978660.346 |
| 11 | 8723336.162 | 1978729.508 | 38 | 8722923.165 | 1978648.489 |
| 12 | 8723329.246 | 1978721.604 | 39 | 8722896.488 | 1978650.466 |
| 13 | 8723326.282 | 1978709.747 | 40 | 8722895.5 | 1978663.31 |
| 14 | 8723336.162 | 1978704.807 | 41 | 8722888.584 | 1978644.537 |
| 15 | 8723369.755 | 1978696.903 | 42 | 8722880.68 | 1978647.501 |
| 16 | 8723368.767 | 1978715.676 | 43 | 8722877.715 | 1978658.37 |
| 17 | 8723343.078 | 1978715.676 | 44 | 8722864.871 | 1978652.442 |
| 18 | 8723314.425 | 1978717.652 | 45 | 8722860.919 | 1978641.573 |
| 19 | 8723293.677 | 1978718.64 | 46 | 8722845.11 | 1978631.693 |
| 20 | 8723262.06 | 1978712.712 | 47 | 8722845.11 | 1978636.633 |
| 21 | 8723274.904 | 1978702.831 | 48 | 8722869.811 | 1978644.537 |
| 22 | 8723293.677 | 1978698.879 | 49 | 8722911.309 | 1978651.454 |
| 23 | 8723304.545 | 1978705.795 | 50 | 8723002.207 | 1978687.023 |
| 24 | 8723311.461 | 1978718.64 | 51 | 8722976.519 | 1978677.142 |
| 25 | 8723311.461 | 1978725.556 | 52 | 8722958.734 | 1978672.202 |
| 26 | 8723289.725 | 1978726.544 | 53 | 8722933.045 | 1978663.31 |
| 27 | 8723273.916 | 1978724.568 | 54 | 8722908.344 | 1978659.358 |

**Figure 4 Accident data in Excel File**

**Step-3:** Create Shape file using above csv/excel file in QGIS.

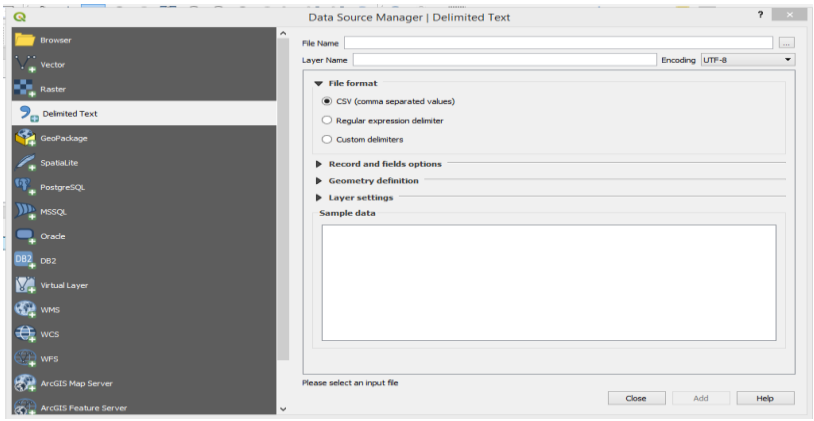


**Figure 5 Create shape file in QGIS**

**Step-4:** Select all options from tool csv to shape file.

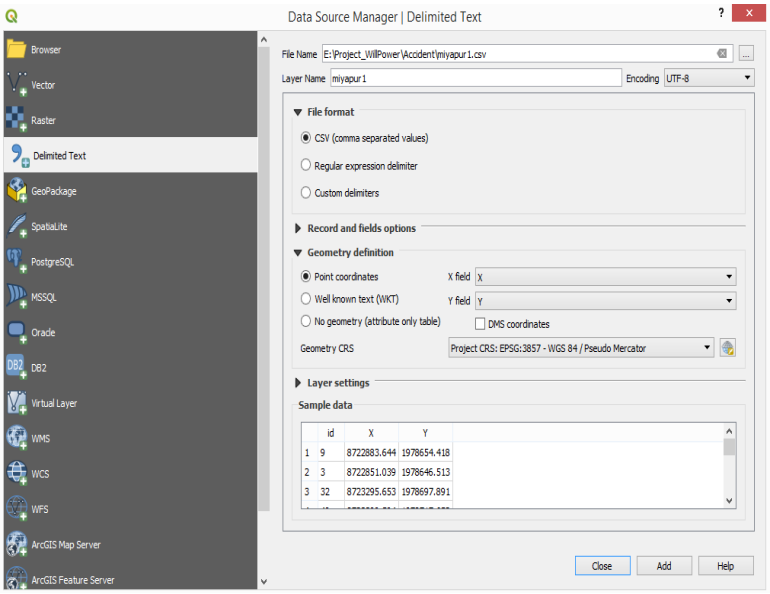


**Figure 6 Select Tools CSV to Shape File**

**Step-5 :** Select column name from options fields based on Latitude and longitude.

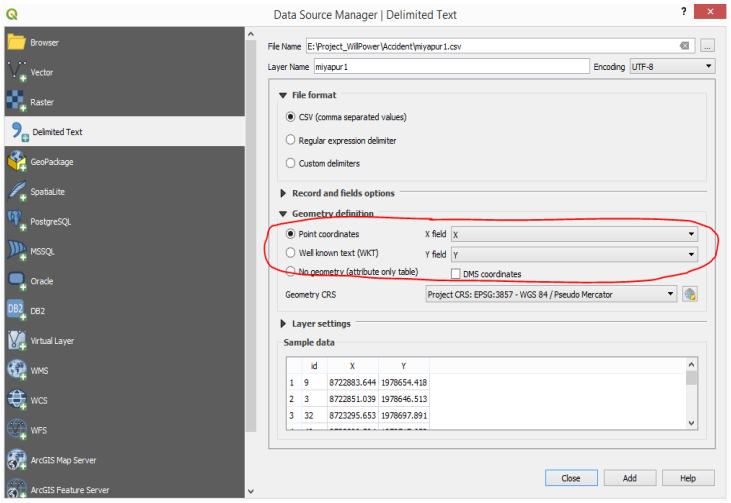


**Figure 7 Column name from Option Fields based on Latitude and Longitude.**

**Step-6**

Click Add so it will create accident shape file and add to map.

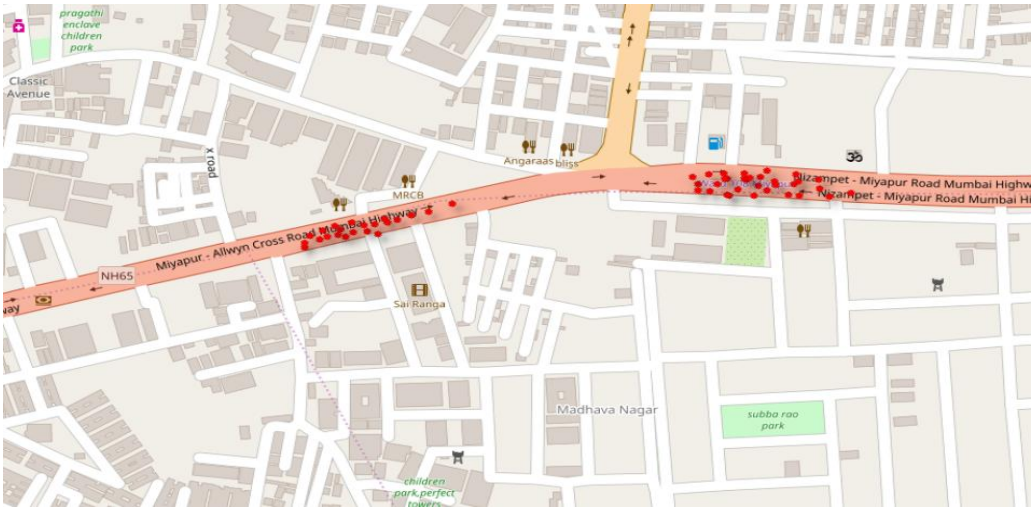


**Figure 8 It Will Create Accident Shape File**

**Step-7**

Use Processing tool to create Hot Spot Analysis.

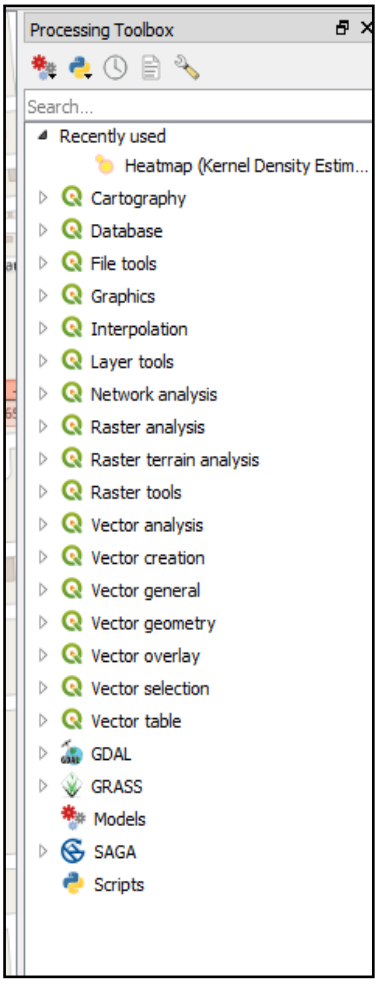


**Figure 9 Use Processing Tool to Create Hot Spot Analysis**

**Step-8**

Use Property tool to create Hot Spot.

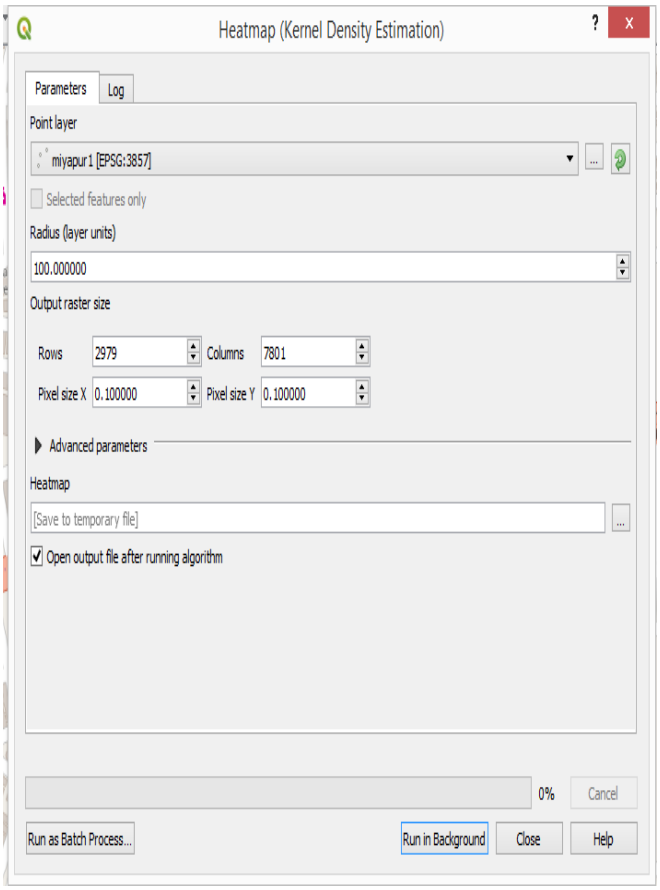


**Figure 10 Use Property Tool to Create Hot Spot**

**Step-9**

Select appropriate options and run the tool.

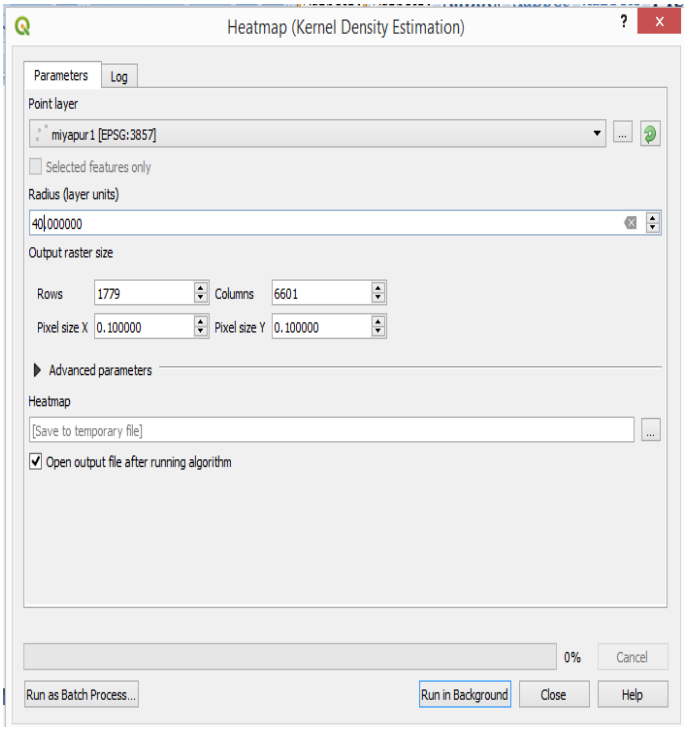


**Figure 11 Select Appropriate Option Run the Tool**

**Step-10**

Generate Hot Spot

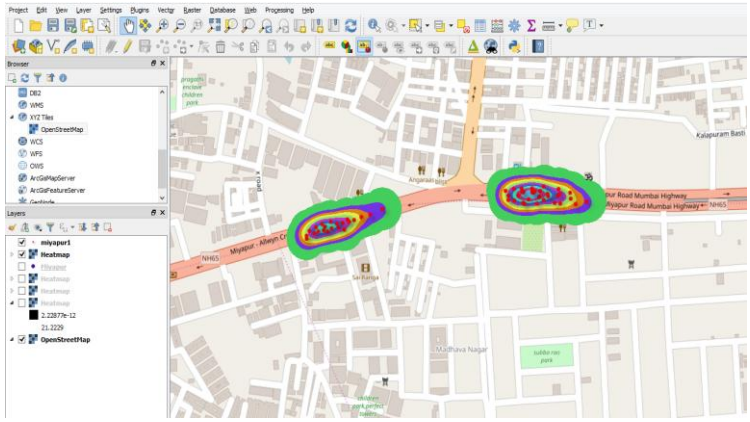

**Figure 12 Generate Hot Spot**

**Step-11**

To identify the main traffic hurdle area

**Figure 13 DilsukhNagar to Chadarghat**

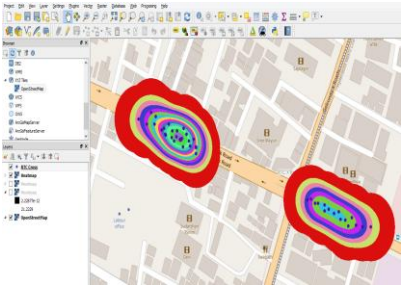

**Figure 14 RTC Cross Road – Secunderabad**

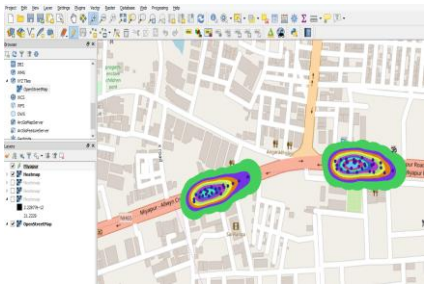

**Figure 15 Miyapur to Kukatpally**

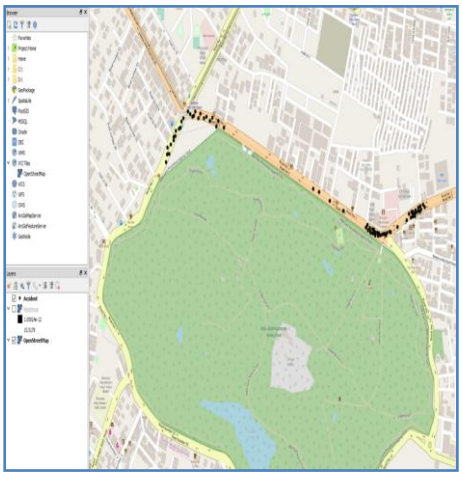

**Figure 16 KBR Park Hot spot location**

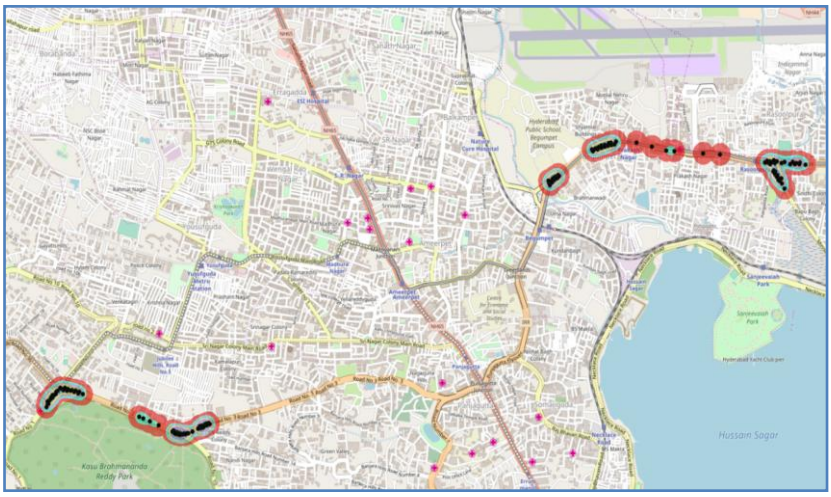

**Figure 17 Begumpet Accident location**

**Step-12** Hot Spot Analysis using QGIS

**Figure 18 Begumpet Hot Spot Location**

**Figure 19 KBR Park Hot Spot Location**

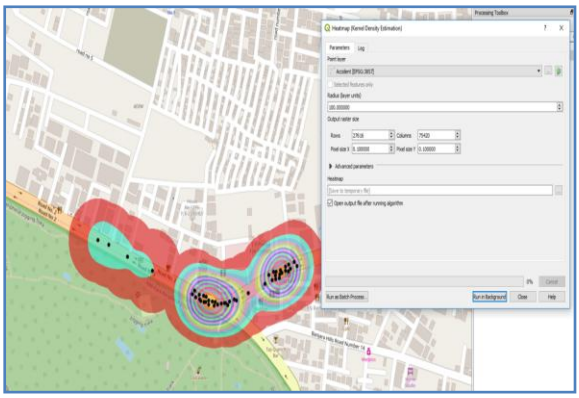

**Figure 20 Using QGIS Tool**

**Figure 21 Afzalgunj to Puranapul Hot Spot**

**Step-13** Hot Spot Analysis based on Accident Points

**Figure 22 Jublie hills – KBR park Road**

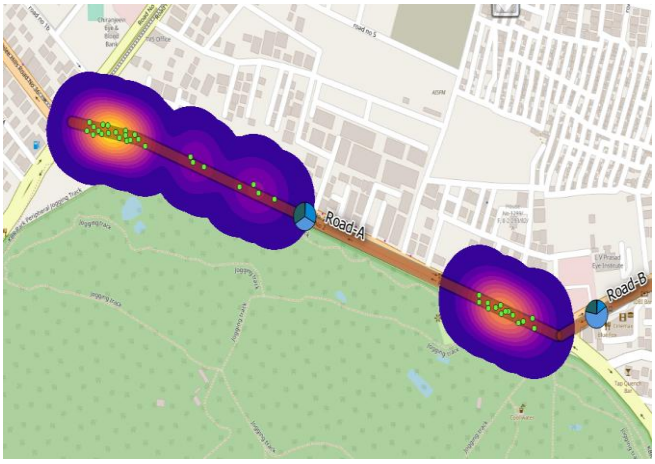


**Figure 23 Kernel density Accident Point in 3D**

## V. RESULTS

Although the number and speed of vehicles has been increased in recent years, the quality of roads have not been improved enough and safety standard of vehicles has not reached a desired level. In addition, the people have not received required instructions and training to improve their attention in terms of safe driving. The present study aims to investigate and compare different types of traffic accidents in terms of spatial aspect. More number of accidents is occurred in central zone compare to the other four zones. Heavy vehicles and were major cause of accidents. Inadequate shoulder width forcing the heavy vehicles to come on to the carriage way there by conflicting with the traffic. More number of non fatal accidents are occurred in the city because of reduction in the journey speed. Most of accidents occurred during day time. More number of accidents occurred due to the driver's fault Swipe & Rear end accidents are more significant for non fatal accidents occurrence in the city. Swipe end, Rear end and Head on collision is evaluated using the logistic regression. Odds against Fatal. Non Fatal were evaluated and found those rear end swipes are significant for non fatal accidents. Attribute table is created and can be modified number of times. We can manage many kind of data using GIS. Data is user friendly we can analysis based on spatial as well as non spatial data. We can do Route analysis. Using Proximity analysis we can easily find out all the utilities or facilities which are nearby some particular point. Using Route analysis we can find optimum route in between two points or between origin and destination. We can find nearest facility to any plot or establishment. GIS mapping data is very useful to get any decision. GIS is the combination of Spatial and non spatial data so we can use spatial as well as non spatial queries for our analysis.

## VI. CONCLUSION

Moreover, a web-based platform can be created, in order to give the users the ability to fill in the forms via Internet, and also provide accessibility to all the interested parties, enhancing the cooperation between them and making the data and the results visible to the public. We can specifically target any location for its accident data. User friendly can take data in any format and provide us platform to work. Very easy to check the progress of rectifying black spots. It is observed that among all categories of vehicles, buses comprised the single highest number of involvement in accidents. This suggests that some more studies should be undertaken in the future to investigate the possible causes of involvement of buses in accidents in order to find appropriate remedial measures. This would in turn help to improve the overall road safety situation in Hyderabad City. Finally, regarding the future aspects of the proposed methodology, there are 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.

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