

# “KALABURAGI CITY CRIME ANALYSIS USING GEOSPATIAL TECHNOLOGY”.

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## ABSTRACT

Kalaburagi also known as Gulbarga, is a district in the Indian state of Karnataka, geographically situated in northern Karnataka between 76°.04' and 77°.42' east longitude, and 17°.12' and 17°.46' north latitude, elevation 454m (1490ft). The aim of this study is to analyze the crime scenario in Kalaburagi city jurisdiction by using hot spot analysis. Based on records of all the police stations of the Kalaburagi city the crime data were classified under various groups of offences such as house break in theft/burglary, vehicle theft, chain snatching, robbery, women harassment and accidents. The crime-prone areas on the basis of distribution of crime incidents are classified into 3 categories i.e. First highest peak hour, Second highest peak hour and Third highest peak hour. The timings under these categories are First highest peak hours: during 6.00 pm to 8.00 pm, Second highest peak hour during 3.00 pm to 6.00 pm, Third highest peak hour during 10.00 am to 3 pm. It was concluded that in Kalaburagi city police jurisdiction, crime rates are increasing day by day but still occurrences of crimes like robbery, chain snatching, house theft, road accidents, vehicle theft, women harassment were of a great concern. The crime patterns change over space and time in an area and hence the data so generated will be of immense help to Karnataka Police Department to utilize GIS tools and techniques as well as hotspot analysis, buffer analysis instead of traditional pin and dot maps to determine spatiotemporal crime patterns as well as to capture crime series and forecast future crime occurrences. A portal has been created using web GIS application to make service available to others within and outside organization it has designed using wide variety of resources and the end user will use these applications to address any number of questions and problems. The public can also be educated with the visual information obtained through GIS analysis to clarify crime concerns and enlist community action and finally to arrive at reducing overall crime disorders.

**Keywords:** GIS, GPS, Hot spot analysis, Crime analysis, Crime mapping, Web GIS, Leaflet.

## INTRODUCTION

**Background:** The crime has spatial attributes like location, time and process. Thus, if this spatial information about crime-prone areas is timely available and with quick ease then it will help in effective policing of the state. Manual processes neither provide accurate, reliable data all the time nor does it help in trend prediction and decision support. Police departments always focus towards the duty of defending the citizen's safety and taking preventive measures to minimize the risk of offense/crime. The common practice of the police department is

to identify locations and times that are more liable to criminal activity. It also results in lower results and ineffective utilization of manpower.

The solution to this consistently increasing problem lies in the effective use of information technology. The policy makers of the police department now a days are using the analog and outdated methods, which has become a very difficult task to prevent the crime there is a need to use new technology.

Geographic Information System (GIS) uses computer-generated maps and Geography as an interface for integrating and accessing huge amount of location-based information. During emergency GIS helps police department to plan effectively, helps to decide priorities, to analyze past historical events, and predict upcoming future events.

The intelligence and criminal record maintenance system is outdated and old it has failed to live up to the requirements and results of the existing crime environment the fact is that the Law enforcement agencies in most developing nations are yet to be computerized for effective record keeping, analysis of cases, easy reference and retrieval, storage of information which in future would provide reliable and comprehensive data round the clock, help in trend prediction and give decision support to Police agencies. Crime is said to be an act which makes an offence and is punishable by law of the concerned Nations.

Crime analysis is a systematically identifying and analyzing patterns and trends in crime and disorders. Crime in Kalaburagi is increasing rapidly with the growing city.

The major crimes reported in Kalaburagi city are House break in theft/burglary, Vehicle theft, Chain snatching, Robbery, Accidents, Women harassment cases and etc by observing above five crimes Accidents and vehicle theft cases are highest, in next place there is Chain snatching and Robbery crime. The policy makers of the police department now a days are using the analog and outdated methods, which has become a very difficult task to prevent the crime there is a need to use new technology. GIS technology can be used to aggregate crime data, identify patterns and clusters. To explore the relationship between crime data and other spatial and non-spatial datasets and accessing the effectiveness of crime prevention strategies.

## Advantages of the study

- By crime analysis the police department can reduce the crime rates by taking control measures like patrolling in the hotspot areas.

- The use of GIS in crime facilitates mapping, visualization and analysis of crime hotspots along with other trends and patterns.
- To help police to take preventive measures like deployment of forces in crime areas.
- Increased ability to analyze crime patterns.
- Increased ability to analyses accidents, accident zones and other road incidents.
- Using GIS, we are able to query data over all the spatial and non-spatial attributes.

**LITERATURE REVIEW**

Charlie Zhang and Michael Peterson (2007) analyzed the crime type’s robbery, assault, burglary and auto theft of Omaha city using geographic information system and ordinary least square regression methods and found spatial intensity of crime more appropriate indicator of neighborhood level than population-standardized crime rates and location quotients.

Pranav Kedia (2016), utilized GIS for crime mapping of Faridabad city of India. A crime data base is created with spatial and non-spatial data of all crime incidents and heat maps are generated using KDE and spatial analysis. Thus generated heat maps showed the crime hotspot areas.

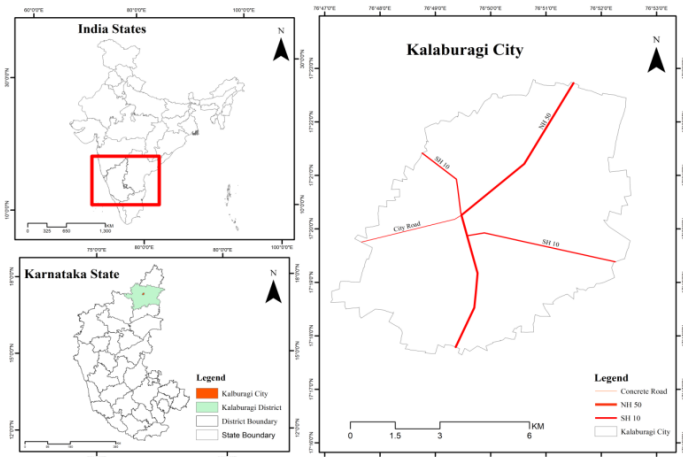
**Objectives of the study**

- To identify the crime hotspots
- To develop a portal of crime hotspots

**STUDY AREA**

**Geographical Location**

Kalaburagi district is a head quarter of "Hyderabad Karnataka" districts and is one of the six districts which were transferred from Hyderabad province to Karnataka state in the year 1956 during the re-organization of the states. The district is one among the 30 districts of Karnataka State. It is located in the Northern part of the state and lies between 76°.04' and 77°.42 east longitude, and 17°.12' and 17°.46' north latitude, covering an area of 10,951 km<sup>2</sup>. It is bounded on the west by Vijayapura district of Karnataka and Solapur district of Maharashtra, on the west by Medak and RangaReddy district of Telegana State, and on the north by Bidar district and Osmanabad district of Maharashtra and on the south by Yadgir district of Karnataka.



**Figure:** Study Area location map.

**MATERIALS AND METHODS**

**Data used**

**Table:** Data used for the study

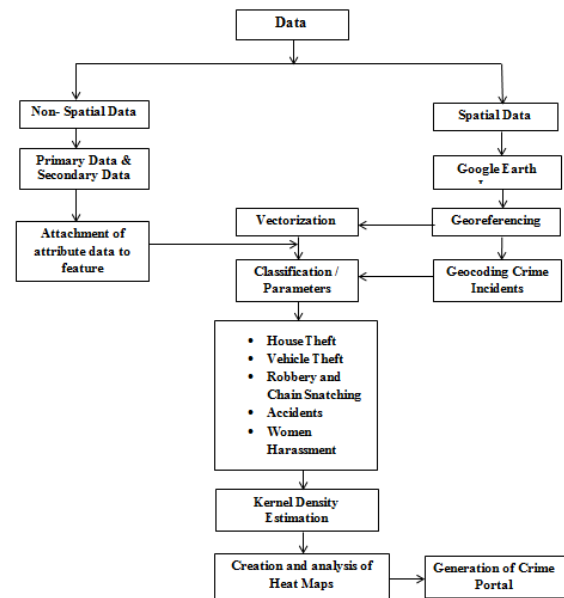
Sl. No.	Data Type	Source
1.	Satellite Image	Google earth
2.	Study area shape file	NRDMS, Kalaburagi
3.	Ancillary data	From police crime reports

The satellite image (Landsat/Copernicus image of the month March 2018,) of the study area is taken by Google earth. The shape file of the study area is taken from District Natural Resources Data Management System Center, Kalaburagi. For the present study five years crime data (i.e., from 2013 to 2018) collected from the police records.

**Materials**

GPS device (Garmin map 78s) is used for the collection of spatial location of crime incidents and ground control point for georeferencing the satellite imagery of the study area. QGIS and Arc GIS software are used for the mapping and analysis of data.

**Methodology**



**Figure :** Flow chart of detailed methodology.

**Data** The present study is based on both non-spatial and spatial sources of data. The secondary data has been obtained from the Google earth.

**Google earth** Google earth satellite images are used for roads, major areas wine shops, hospitals, colleges etc., for feature capture purpose. Tabular and text format secondary data and

information which are the basic requirement of the project have been collected for digitization of study area.

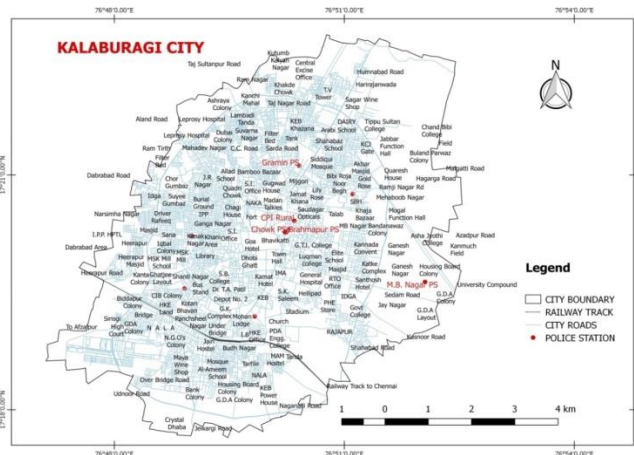


Figure: Base Map.

**Data collection**

Collected crime data available in FIR registers and computerized with the help of Police department staff. The problem was the non-availability of GPS coordinates with the crime incident data, so we manually searched each crime incident locations in the Google map and collected the geocoordinates with the help of physical address.

**Data Cleaning**

The crime data has lack of uniformity. For example, date and time entered by various operators are in different formats. Rectified them into a uniform format, removed unwanted data, corrected coordinates properly, then cleaned and made compatible for GIS tools.

**Creation of Database/Geospatial format files**

With the help of QGIS and ArcGIS software tools, created spatial layers of various crime data and stored in Geospatial database for querying, analysis and composing maps.

**Analysis Tools:** When Crime incident points are plotted on a map, these points are distributed in dispersed, clustered and Hotpoint patterns. Heat map can also be used to know the concentrated crime areas of study area. In the present study KDE (KERNEL DENSITY ESTIMATION) method used from QGIS tool.

**Heat Maps: KDE-Kernel Density Estimation**

The Kernel Density tool calculates the density of features in a neighborhood around those features. It can be calculated for both point and line features.

**Data from NRDMS**

The present study is based on both non-spatial and spatial sources of data. The secondary data has been obtained from the Google earth. The district boundary vector data is provided by District NRDMS center. The study area boundary is digitized from satellite imagery. The five year crime data since 2013 to 2018 of are collected by visiting the city police stations. Total 3572 crime incidents data are collected from the police records. Thus collected data is entered into excel format, as shown in figure.

YEAR	WHEELS	S/No	PoliceStation	Crno	Date	Type	Place	Latitude	Longitude
2013	4	1	R G NAGAR	46/2013	17/03/2013	TATA INDICA	SANTOSH COLONY	17.305992	76.830212
2013	4	2	M B NAGAR	90/2013	18/06/2013	TATA INDICA	NEAR TOYOTA SHOWROOM	17.328382	76.857194
2013	4	3	ASHOK NAGAR	102/2013	29/06/2013	AUTO	CENTRAL BUS STAND	17.326282	76.817294
2013	4	4	R G NAGAR	105/2013	14/09/2013	CAR	SHETI TALUKES NEAR PETROL BUNK	17.348014	76.825367
2013	2	1	station bazar	13-Jan	02/01/2013	Two wheeler	koranti hanuman temple	17.311679	76.835396
2013	2	2	station bazar	13-Mar	05/01/2013	Two wheeler	verikateswar nagar	17.329686	76.834152
2013	2	3	R G nagar	13-Apr	12/01/2013	Two wheeler	brahmapur	17.334769	76.829675
2013	2	4	Brahmapur	13-May	18/01/2013	Two wheeler	s b appa garden	17.337183	76.829722
2013	2	5	Brahmapur	13-Jul	19/01/2013	Two wheeler	saral bazar shankaralinga temple	17.340799	76.840059
2013	2	6	station bazar	15/2013	18/01/2013	Two wheeler	pda engineering college	17.338091	76.829883
2013	2	7	chouk	16/2013	24/01/2013	Two wheeler	shiraji nagar	17.362599	76.844095
2013	2	8	M B nagar	18/2013	26/01/2013	Two wheeler	swasthi nagar	17.329682	76.857887
2013	2	9	M B NAGAR	13-Nov	24/01/2013	Two wheeler	GDA HOUSING BOARD COLONY	17.353286	76.846697
2013	2	10	MB NAGAR	13-Feb	03/01/2013	Two wheeler	BASAVESHWAR HOSPITAL	17.328816	76.853988
2013	2	11	station bazar	32/2013	19/02/2013	Two wheeler	BALAJI POLY TECHNIC COLLAGE	17.309941	76.821136
2013	2	12	MB NAGAR	25/2013	16/02/2013	Two wheeler	OM NAGAR GATE	17.329013	76.865525
2013	2	13	ROIA	17/2013	23/02/2013	Two wheeler	MUGURI	17.342696	76.844548
2013	2	14	CHONK	51/2013	23/02/2013	Two wheeler	NEAR ANURUP SHAHA HOSPITAL	17.348869	76.834225
2013	2	15	RIG NAGAR	20/2013	23/02/2013	Two wheeler	SHEETY COMPLEX	17.345975	76.825066
2013	2	16	CHONK	55/2013	27/02/2013	Two wheeler	NEHARU GANU	17.328815	76.841429
2013	2	17	station bazar	48/2013	09/03/2013	Two wheeler	P&T COLONY	17.331174	76.838407
2013	2	18	ASHOK NAGAR	39/2013	16/03/2013	Two wheeler	NEAR CENTRAL BUS STAND	17.326282	76.817294
2013	2	19	station bazar	58/2013	21/03/2013	Two wheeler	VG WOMENS COLLAGE ROAD OPP RAIL	17.319799	76.839012

Figure showing the Data collected for Robbery and Vehicle theft.

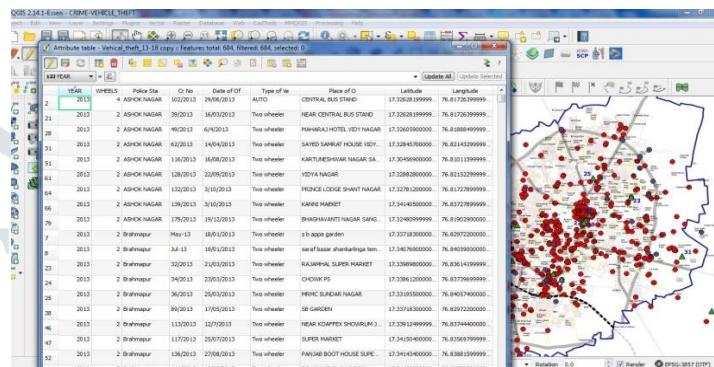


Figure: Showing the attribute tables with the XY coordinate of vehicle theft crime

**Classification crimes/Parameters**

The 3572 crime incident data is classified in to six classes. They are,

- House break in theft/burglary
- Robbery
- Chain snatching.
- Vehicle theft
- Accidents
- Women harassment

Thus classified crimes are separated year wise as shown in the table.

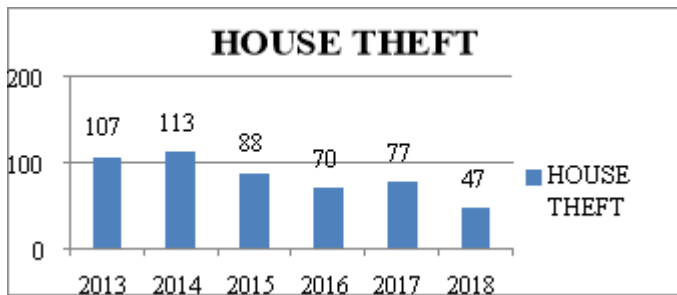
**Table:** showing five years crime data reported in Kalaburagi City.

YEAR	HOUSE THEFT	ROBERRY	CHAIN SNATCHING	VEHICLE THEFT	ACCIDENTS	WOMEN HARASSEMENT	TOTAL
2013	107	51	31	86	N/A	N/A	275
2014	113	55	36	121	N/A	N/A	325
2015	88	47	24	151	586	62	958
2016	70	50	26	126	531	50	853
2017	77	35	4	109	463	60	748
2018	47	24	1	94	212	35	413
	502	262	122	687	1792	207	3572

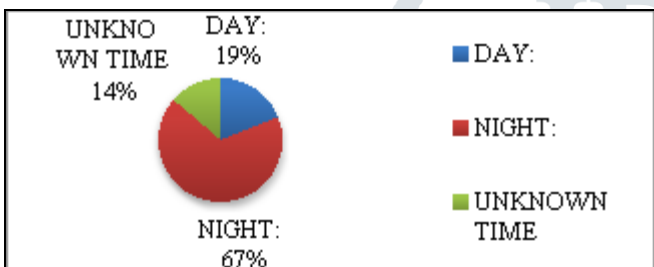
From the collected 3,572 crime data, it's evident that accidents and vehicle theft cases are highest, in next place there is house theft, robbery, women harassments, and chain snatching crimes. By observing the above data starting from 2013 to 2018 the crime rates are consistently fluctuating year by year which shows there is much more need to have advanced technology.

**RESULTS**

**House Break in Theft:** Total 502 house break in theft (HBT) cases were registered in kalaburagi city during 2013 to June 2018. From the processed data, we observed that 67 % of House break in theft crime occurred during night time where as 19% in day time and 14 % in unknown time.



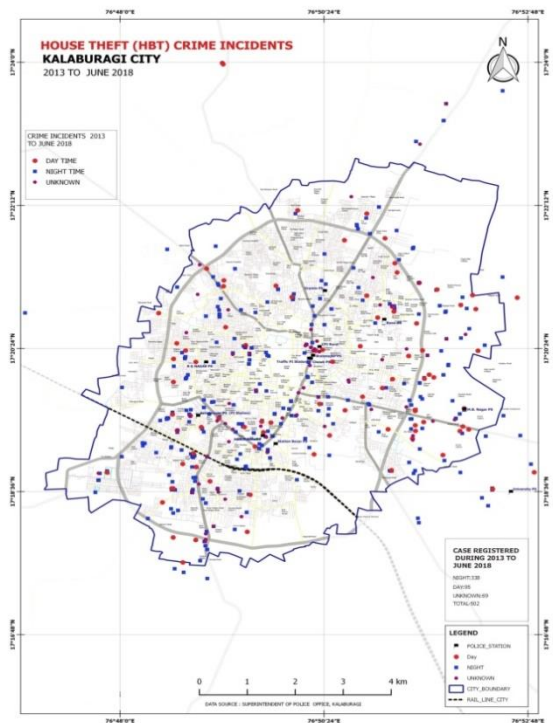
**Figure:** Bar Chart showing Crime Incidents during 2013 to June 2018.



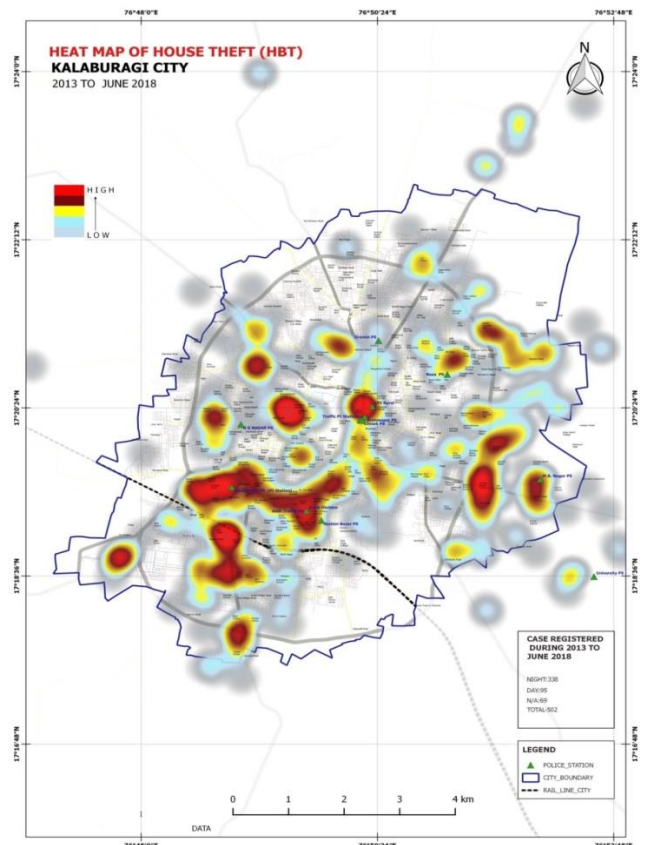
**Figure:** Pie Chart showing timely house theft locations.

Total 502 house break in theft (HBT) cases were registered in Kalaburagi city during 2013 to June 2018. Using query process it's identified that during Night 338, during Day 95 and in Unknown timing 69 crime incidents.

From the analysis the identified hotspots areas are Datta Nagar, Banjara road, Jaya Nagar, Shakti Nagar, Ganesh Nagar. Reasons for the crime hotspots are, the houses are apart from each other. General public movements and vehicles movements are very low.



**Figure:** Map showing of House theft crime incidents.



**Figure:** Heat map showing hotspot of House theft crime incidents.

Robbery and Chain Snatching

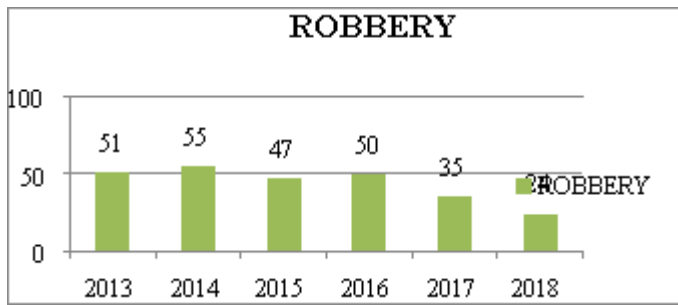


Figure: Bar Chart showing year wise Recorded Robbery incidents.

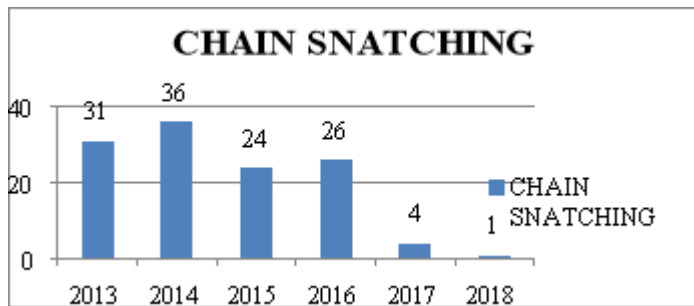


Figure: Bar chart showing Year wise Recorded Chain Incidents.

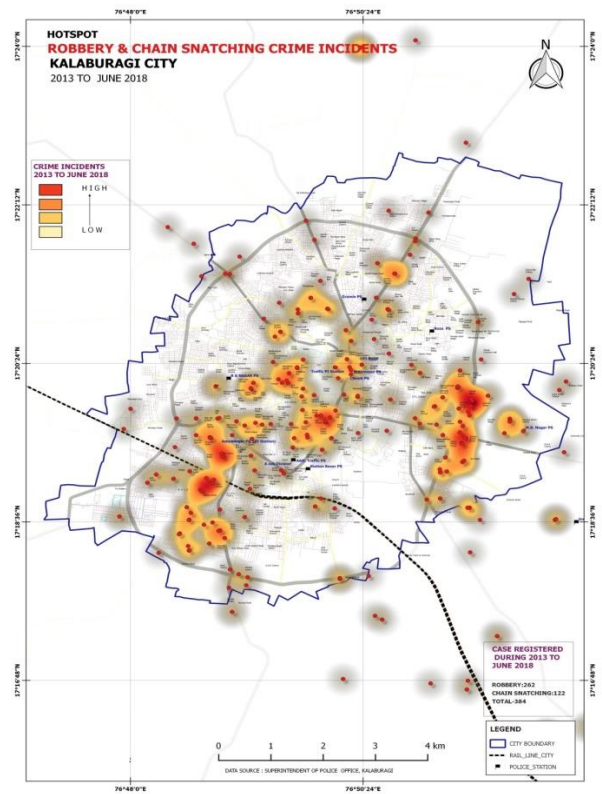


Figure: Heat map showing robbery and chain snatching hot spots.

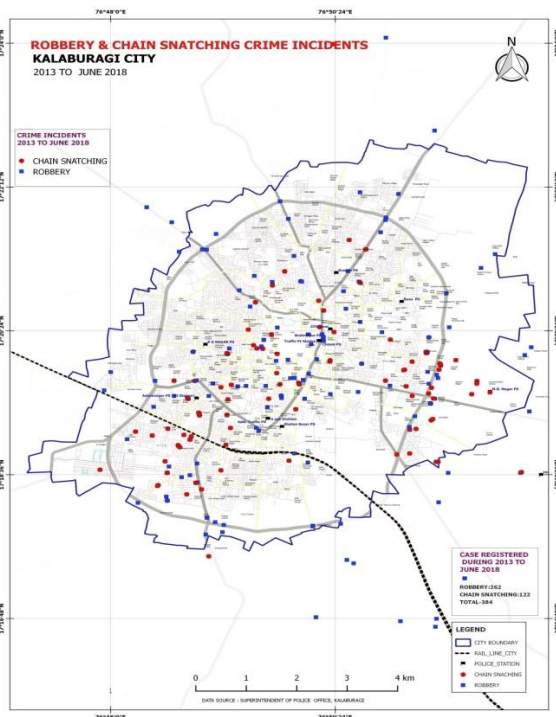


Figure: Map Showing robbery and chain snatching locations.

Spatio-temporal data: As location, time is also a key factor in crime management to analyze crime. Therefore Time of offence has been collected and added into spatial crime incident database, this helps us to understand and analyze where and when the crime is at high and low. With the spatio-temporal data we queried and categorized the 24 (1 hour bins) hours into six time slots for ease. The below histogram shows the hour based number of crime incidents.

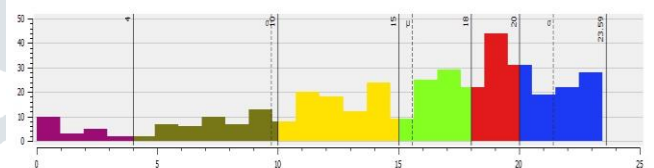


Figure: Histogram of time with respective to number of crime incidents, based on Five year crime data.

From above histogram we can clearly observe the crime peak hour. The time from 6.30 to 7.30 is the highest danger zone. This hour is highest and has more than 40 cases registered during the 4 years. We plotted each slots on map to identify which location is risk in which time slot.

Generated time based crime GIS maps to identify the peak hour crime incidents locations. The below map shows the time based crime spatial distribution in the city.

**CRIME PEAK HOURS**

Listed the 4 peak hours' time slots to identify which time is high risky.

1st – 6.30 TO 7.30 – HIGHEST CASES- Above 40 CASES REGISTERED.

2nd – 7.30 TO 8.30- SECOND HIGHEST-Above 30 CASES REGISTERED.  
 3rd – 4.30 TO 5.30 – THIRD HIGHEST –Above 25 CASES REGISTERED.  
 4th -1.30 TO 2.30 – THIRD HIGHEST –Above 20 CASES REGISTERED.

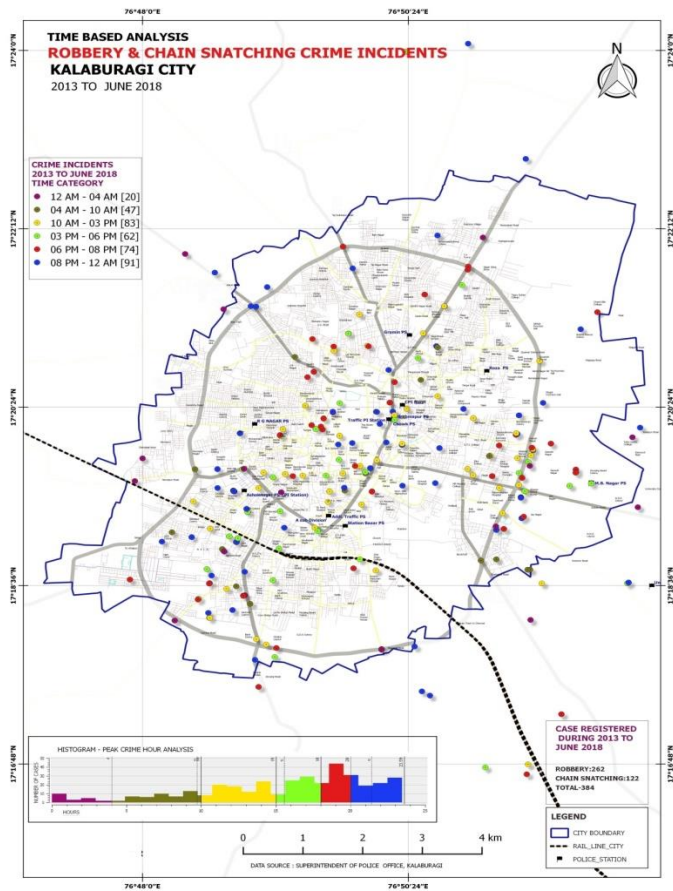


Figure: Map showing time based robbery and chain snatching crime incidents.

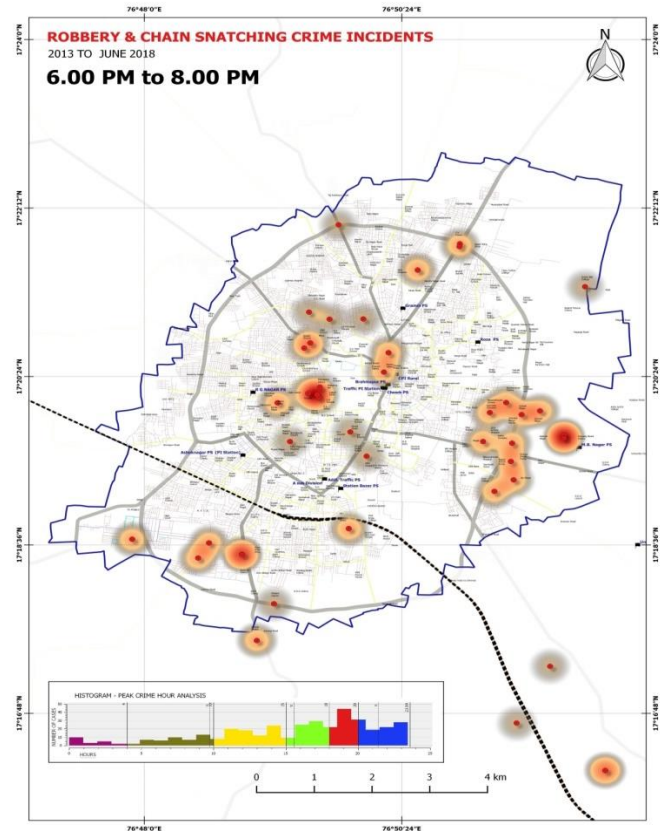


Figure: Heat map showing robbery and chain snatching Time Based hot spots during 6.00 pm to 8.00 pm.

**Crime prone areas observed on peak hours:**

Note: identified crime prone area on the bases of clustered distribution of crime incidents. The below maps provides comprehensive crime patterns.

First highest peak hours: during 6.00 pm to 8.00 pm crime prone areas

1. Ganesh Nagar, Housing board colony
2. Sharan Nagar, lalgeri cross
3. Basweshwar Chowk, Adarsh Nagar, Ganesh Nagar,
4. Jaya Nagar surrounding area.

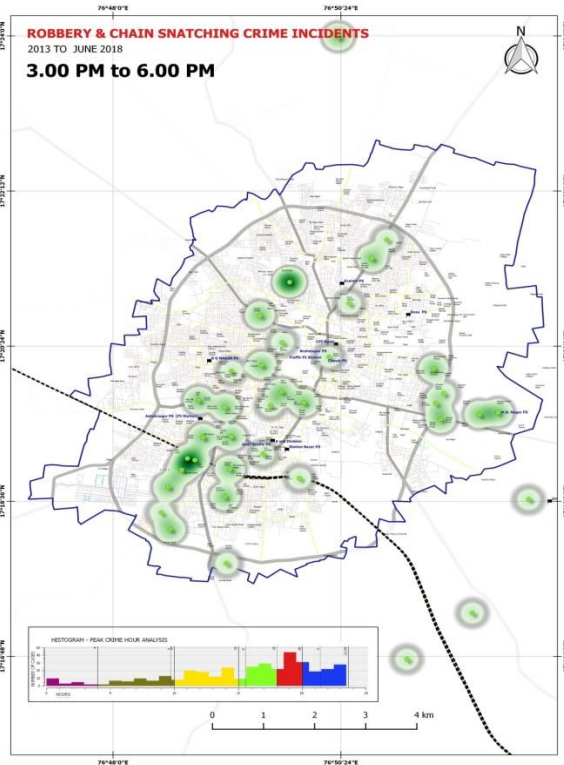
Second Highest peak hour during 3.00 PM TO 6.00 PM crime prone areas

1. Datt Nagar, Banjara road,
2. Mahadev Nagar.

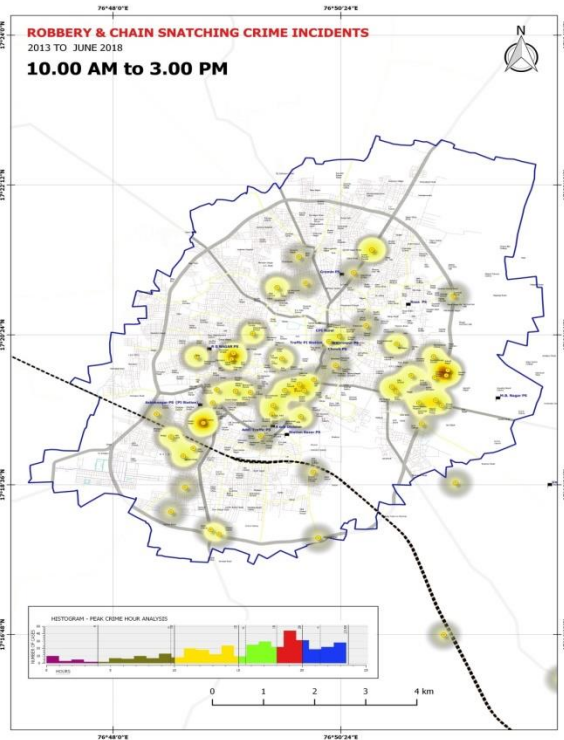
Third Highest Peak Hour: during 10.00 AM TO 3 PM Crime Prone Areas

1. Adarsha Nagar, Basaweshwar Chowk and Ganesh Nagar surroundings
2. Khani kanak Nagar and surroundings
3. CIB colony

Reasons for the crime hotspots are, usually chain snatching hotspots dispersed throughout the city as the ladies are un aware of this kind of crime. Generally at morning and evening more cases are registered as ladies come out from their house.

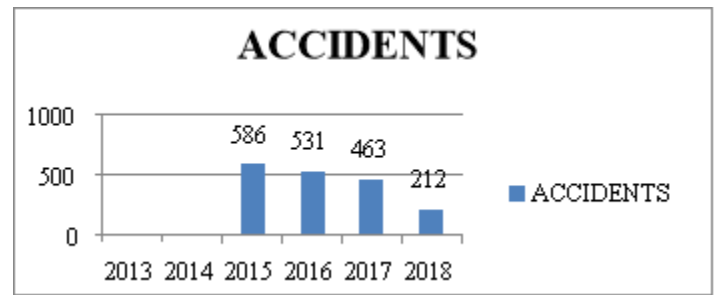


**Figure:** Heat map showing robbery and chain snatching Time Based hot spots during 3.00 pm to 6.00 pm.



**Figure:** Heat map showing robbery and chain snatching Time Based hot spots during 10.00 am to 3 pm.

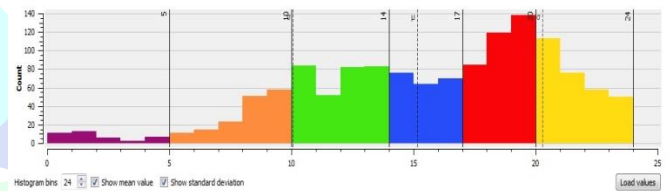
**Accidents in Kalaburagi city**



**Figure:** Bar Chart Showing year wise Recorded Accidents Incidents.

The above graph shows Crime data are 2013 and 2014 data not available, in year 2015 approx 586 cases are registered and likewise 2016 approx 531 ,2017 approx 463 ,2018 approx 212 cases are registered.

Fatal accidents are increasing rapidly in Kalaburagi city; during 2015 to 2018 total 1792 accidents were reported in city itself. Accident spatio -temporal data has been collected and created spatial files and generated heat maps and various GIS maps which intend to help the planners to take measures to mitigate future accidents.



**Figure:** Histogram showing accident peak time.

The above histogram shows the peak accidents time. Below map shows the hotspot area in peak hours.

Reasons for the crime hotspots are, more accidents occur where there is crossing of roads which are not having traffic signals. Some areas are adjacent to state highway (SH)10. Roads crossing are very difficult here. Some hotspots are nearer to bar and wine shops the causes may be of drink and drive.

**Some facts about accidents:**

- 214 road crashes occur every day in India.
- Two wheelers account for 25% of total road crash deaths.
- 20 children under the age of 14 die every day due to road crashes in in the country.
- 377 people die every day, equivalent to a jumbo jet crashing every day.
- Two people die every hour in Uttar Pradesh – State with maximum number of road crash deaths.
- Tamil Nadu is the state with the maximum number of road crash injuries

Delhi (City), Chennai, Jaipur, Bengaluru, Mumbai, Kanpur, Lucknow, Agra, Hyderabad, Pune.

Source of Information: National Crime Records Bureau, Ministry of Road Transport & Highway, Law commission of India, Global status report on road safety 2013.

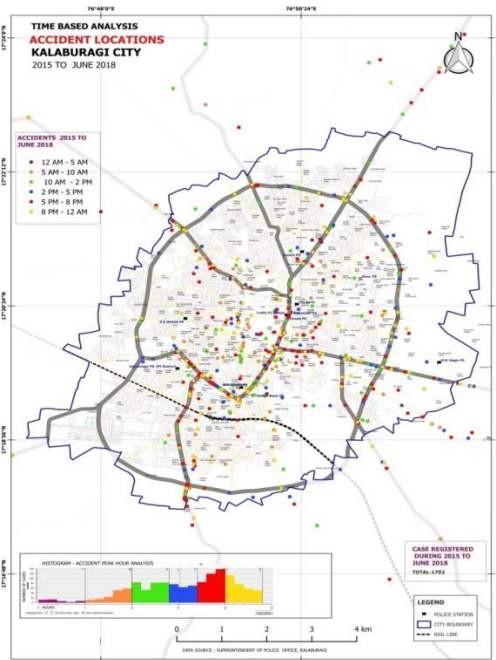


Figure: Map showing time based accident locations.

Accidents and Bar/Wine shops locations

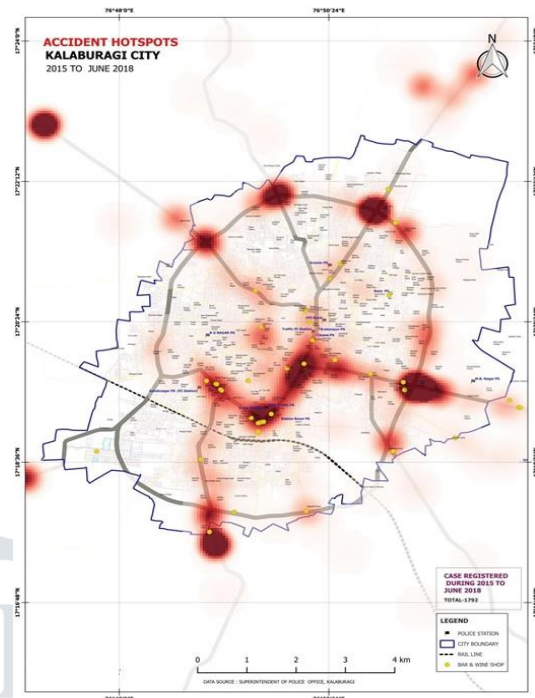


Figure: Map showing accident prone zones and bar and wine shops locations.

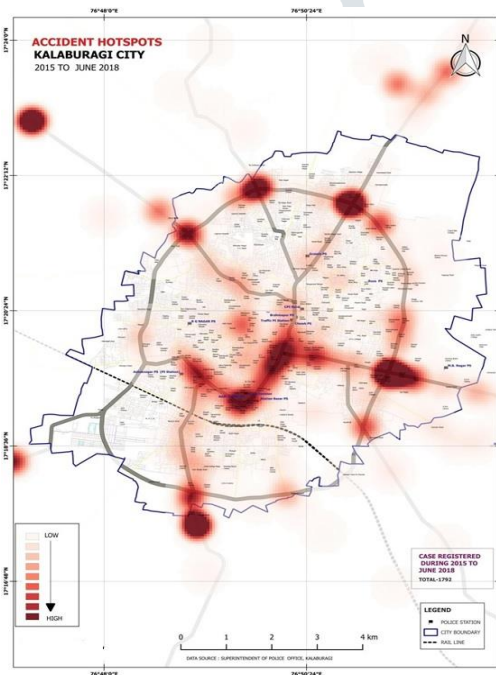


Figure: Map showing the accident prone zones. Maximum accidents are occurring in the roads cross.

Vehicle Theft Crime

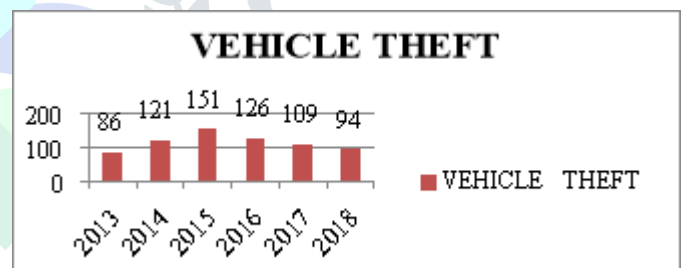


Figure: Bar Chart Showing year wise Vehicle Theft Incidents.

Vehicle theft -Gulbarga city registered 687 vehicle stolen cases between 2013 to 2018 June, which comes up to approximately 13 vehicles theft cases per every month. 80 % of theft cases were two wheelers.

Case registered during 2013 to June 2018.

Four wheeler 53, two wheeler 634 approximately 687 cases are registered.

Below map shows the crime distribution of vehicle theft locations and heat maps, these maps will helps to identify the hotspot location of vehicle theft crime.

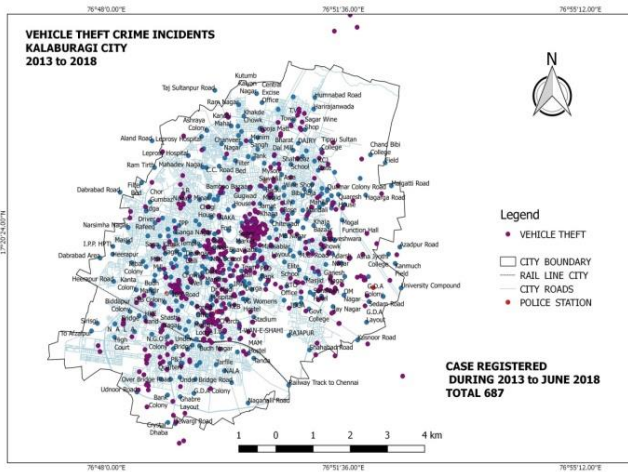
Recommendations: With the help of heat map, physical survey needs to be carried out for the better understanding of the spots.

Hotspots are bus stand surroundings, railway stations, market roads, masjid etc.

Reasons for the crime hotspots are in vehicle theft hotspots zones as there is no pay and park facility. People park their

vehicles in front of the shops and commercial complex without any security. Even though there are parking facilities in some places, people park their vehicle outside the parking lot. These are the major causes.

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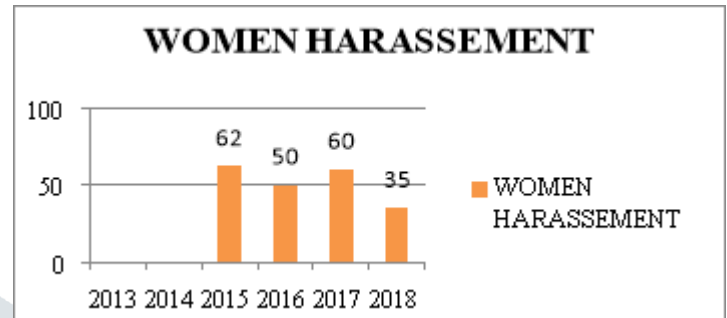
**Figure:** Locations of Vehicle theft crime incidents in kalaburagi city.

Case registered during 2013 to June 2018.

Four wheeler 53, two wheeler 634 approximately 687 cases are registered.

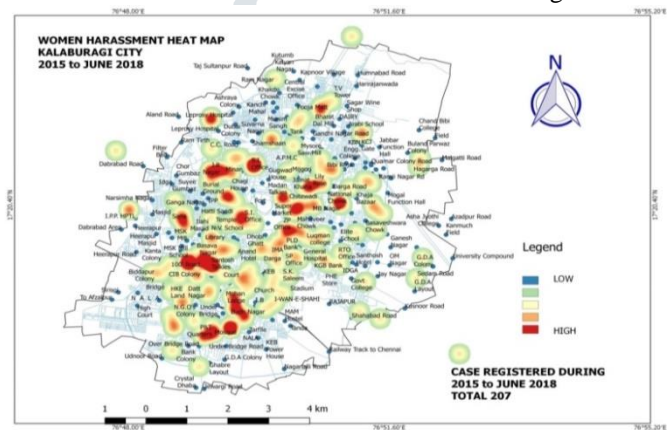
Below map shows the crime distribution of vehicle theft locations and heat maps, these maps will helps to identify the hotspot location of vehicle theft crime.

**Women Harassment Cases**



**Figure:** Bar Chart showing women harassment cases year wise.

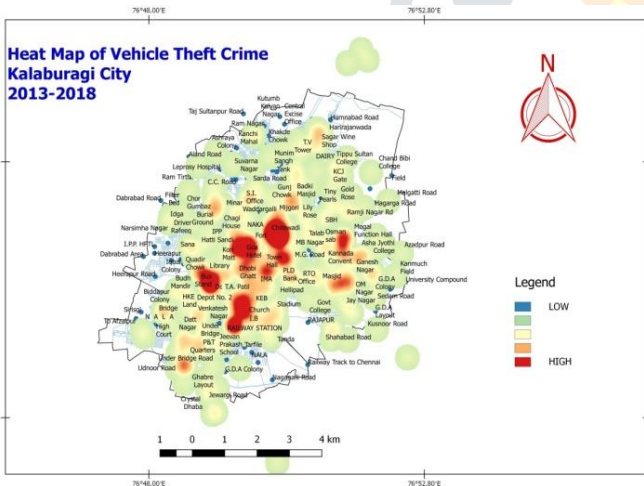
The above graph shows Crime data of 2013 and 2014 the data for these two years are not available; Approximately 207 women harassment related cases have been registered in



kalaburagi during 2015 to June 2018. The time and places of women harassment offence data has been scrutinized digitized and generated various analytical maps to identify hotspot. These maps helps police department to reduce crime rate in the city by better planning and better policing. These maps help to carry out law awareness programs.

**Figure:** Women Harassment Heat map

Hotspots are Santosh Theater, Mohan lodge, P and T quarters, Government College National Chowk, JR Nagar, Budha Nagar.



**Figure:** Heat map showing Vehicle theft hot spot.

Hotspots are Central Bus stand surroundings, Railway stations, Market roads, Masjid etc.

Reasons for the crime hotspots are in vehicle theft hotspots zones as there is no pay and park facility. People park their vehicles in front of the shops and commercial complex without any security. Even though there are parking facilities in some

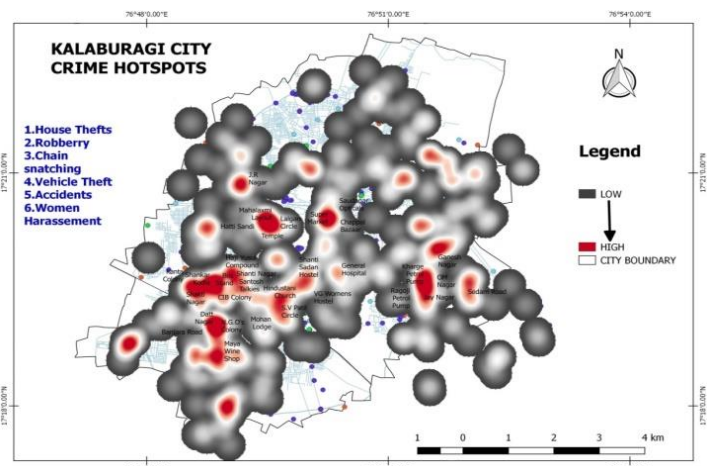


Figure: Kalaburagi city crime Heat Map.

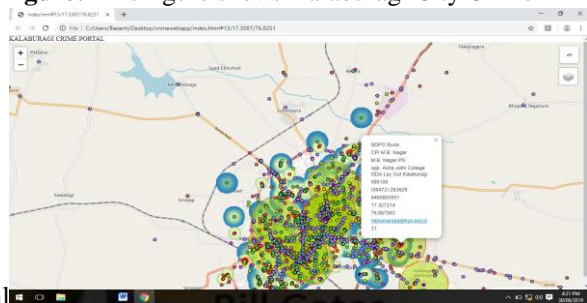
Banjara road, NGO’s colony, Maya wine shop, Central Bus stand, CIB Colony, Shakti Nagar, GK complex, Mohanz lodge, S.V.Circle, Shanti Nagar, JR Nagar, Ganesh Nagar, Mahalaxmi layout, VG women’s college, Super market, Chappla Bazar, these are the high hotspots areas of crime recorded of House break in theft/burglary, Robbery, Chain snatching, Vehicle theft, Accidents and Women harassment. Police personnel’s are suggested to increasing patrolling and to establish new police station to cover these areas.

**Web Mapping with QGIS2Web:** Web mapping is a great medium to publish our GIS data to their web and make it accessible by other users. “Leaflet” is the trending and leading open-source JavaScript library. It has designed using wide variety of resources and the end user will use these applications to address any number of questions and problems.

**Kalaburagi City Crime Portal**



Figure: This figure shows Kalaburagi City Crime



Portal Figure: This figure shows police station Information.

**Discussions**

The map showing the locations of police stations were created and the corresponding administrative area were delineated for each station. The attribute details including crime records details

were collected to create the Geo database for crime analysis within Kalaburagi city. The crime details were represented as spatial function in the geographic domain to visualize the pattern of crime within the area. The details of crime committed between the years 2013 to 2018 were collected for the crime analysis. Based on the distance decay analysis, cost distance from each police station was computed. The crime prone areas observed on peak hours based on the analysis and identified the proximity locations of crime.

**Crime Mapping**

In the present study, past Five year data had been collected to analyze the pattern followed by crime and clusters of concentration in which more number of offences had took place and where the concentration of different crime spots have been captured using hand held GPS and are brought into GIS platform, as stated in the objectives the crime occurrences within the limits of Kalaburagi police station was located. According to the department norms, crime has been classed in to nine categories according to City Crime Branch (CCB), Bangalore. The crime data were classified under the group of property offence as Robbery, House theft (day), House theft (night), Chain snatching, Murder, Mobile theft, Motor Vehicle theft, two wheeler theft, Cattle theft, Cheating and Criminal breach of trust. For our study and analysis we had taken the six crimes which are House break in theft/burglary, Vehicle theft, Chain snatching, Robbery, Accidents, Women harassment cases. To know the spatial pattern followed by crime and its concentration and to analyses the “Hot spot” in the selected area in each crime spots have been located using GPS while locating the points where the Crime has occurred the time, date and addresses have also been included to the corresponding points.

Maps display the locations where concentration of crimes have occurred can be used to helps to direct patrols and to increase the patrolling to reduce the crime to places they are most needed and maps may prove invaluable in solving criminal cases. This kind of visualized representation will help in understanding of where and why crimes occur and can improves the attempts to fight crime and can help police protect citizens more effectively. Visualizing all the crimes records, offender profile, socio-economic condition of the area and cultural aspects can possible with GIS technology.

**Crime analysis**

Crime Analysis is defined it is a systematic and analytical processes directed at providing timely information and relevant information related to crime patterns and trend correlations in order to help the concerned officials and administrative personnel’s, and police dept. In planning the deployment of resources and etc for the prevention and suppression of criminal activities, which helps the investigative process, and increasing apprehensive environment and the clearance of cases. It helps number of departmental functions which are very essential to prevent the crime like patrolling deployment, to carry out special operations; it helps to investigations, planning and research for crime prevention, and many administrative services.

**Hot spot analysis:** Hot spots are clusters of geographical areas that contain an unusually high concentration of crime vents. However, not All clusters are hotspots because the environments that help Generate crime-the places where people are-also tend to be clusters, Therefore, any definition of hot spots has to be qualified (Harries1999) defined hot spots “as small places in

which the occurrence of crime is so frequent that it is highly predictable, at least over one year period of when the hot spot analysis was done on few crimes individually to find the change over a period, the change seemed to be significant. The results of temporal analysis made on the hotspots of crimes revealed that not only the Locations of the hot spots had changed in two years, but also their numbers of occurrences have also changed. The police officers patrol high and low crime areas differently, responding to their own perceptions of the crime rate in an area. An alternative method of visualizing high volume Crime hot spot is the use of continuous surfaces. Continuous surfaces allow the distribution of crime across a whole area to be visualized and easily understood.

### Problems and Implementations in Crime Mapping

The present study of crime mapping and analysis will be highly helpful if further in depth study is carried out in charting out frame work for police planning and preventive measures will help to increase their awareness of hotspots of crime. The present study will be a model for the implementation of GIS technology in kalaburagi city policing.

Kalaburagi police department has established city command center in view to reduce the crime rate in kalaburagi city as this command center uses GPS and wireless technology. It has 14 cars and 2 bikes for patrolling continuously in crime prone Areas and 4 bikes and 2 cars exclusively for womens.

### Office of Asst, Commissioner of Police, Traffic Sub Division, Kalaburagi



Figure: City Command Center, Kalaburagi.



Figure: Hot spot maps used by City Command Center, Kalaburagi.



Figure: Maps which prepared during this work are being used by Command Centre, Kalaburagi.

As we collected the five year data from the police department and identified the crime hot spots helped police department a lot especially to this police command center as it meant for focusing the areas which we shown as hot spot in the maps.

This command center used our maps for training there officials who are on patrolling duty so that they can easily patrol though the areas which are crime prone.

We are glad to be a part of the police department that our work had contributed to assist them to reduce the crime rate.



Figure: Example of Accident prone area Jaya Nagar.

### CONCLUSION

The study was an attempt to find out the most vulnerable crime locations or the black spots in the Kalaburagi city. By using KDE analysis, identified various hot spots for various crimes. Also based on the analysis, we observed crime peak hours, major accident prone zones, and major vehicle theft prone zones etc. Using these maps decision maker can select suitable measure for reducing crime rate in the city.

The location of a crime and the use of geographic space by offenders are important components of the criminal event. That is why, the usage of GIS and crime mapping is vital for analyzing and identifying crime patterns and trends. In this concern, as indicated before, GIS and crime mapping support a broad variety of problem solving and spatial decision-making applications in crime and crime locations.

GIS lets agencies utilize more information more intelligently. It is certain that the above benefits, problems and policy implementations do not include everything about GIS and crime mapping. There may be many other benefits, problems,

and policy recommendations required for police departments that use or intend to use this technology, of course, to reach that new information requires new research and study.

#### Some of the suggestions were listed as below

1. The locations where House break in theft incidents occurred has to be patrolled very frequently.

2. Public awareness should be done to avoid chain snatching especially for ladies to be cautious while wearing valuable ornaments. The announcements which are announcing in Bus stands and these announcements has to be done in every public places timely etc.

3. Night Patrolling should be increased by identifying the robbery prone locations to avoid the robbery incidents

4. Many places which are mentioned in this report are accident prone zones where the major cause of the accident is the absence of traffic signal system even at the junctions of 4 or 5 lane roads, which is observed in the areas like Om Nagar and Jaya Nagar which are adjacent to the State Highway 10.

5. New police stations should be established within the radius of crime hot spots to respond quickly and to prevent the crime before it happens.

6. After analyzing the crime data we found certain locations which are crime prone and visited them with the help of police department to identify the factors which are directly and indirectly playing a role in crime incidents. In this regard further detailed studies are required.

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