

Role of Traffic Network in Monitoring Crime and Violence Patterns in Karachi

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Abstract: Crime and geographical accessibility has very special relationship, if monitored on appropriate time it could resolve many complex issues of the crime dynamics. Karachi being the largest city of Pakistan is also very high in the intensity of street crimes that often has very close relationship with the network of the roads. This paper will assess the potential of Geographical Information Systems (GIS) for the analysis of crime pattern and its relationship with the road network in Karachi that would be beneficial for various crime agencies. Present research aims to provide a collective set of methods and techniques for geospatial analysis and 3D mapping of crime scenes. After identification of Hotspots assessment of relationships between robbery or snatching clusters and their spatial neighborhood is initiated by including the urban milieu. For obtaining the desired target copious geospatial data as well as a three-dimensional model is included for analysis. The combined and mutual effort of crime mapping methods with modern 3D modelling helps to facilitate on the spot clutch of multipart spatial phenomena in mapping of crime, and fruitful for both, the communal and responsible decision makers.

Keywords: GIS, Geo-spatial 3-D modeling, Crime Analysis, Hotspot.

INTRODUCTION

Karachi is the financial capital of Pakistan and commercial hub as well as the largest port of Pakistan and having mixed cultural communities. The high incidence of crime in Karachi is one of the most devastating problems. This high rate of crimes might be the outcome of the negative effects of the low economic growth rate of the past few years with its accompanying high rate of unemployment, a high population growth rate, urbanization and a deficient legal system, limited police budget etc. The counter-argument was that the Karachi police and crime controlling agencies should strive to use its available resources more effectively and optimally. Nevertheless, it always challenges to the academics of how limited resources can be utilized optimally. The recognition of crime hot spots [1] was perhaps a watershed in refocusing attention on spatial features of crime. Policing arrangements are inherently geographical phenomena [2], scrutinizing the place of the criminal event is focal point for geographers. They often use maps to look for crime patterns, for example, using metric topology [3]. Geography of criminology focuses on criminal patterns within particular built environments and analyzes the impacts of these external variables on people's cognitive behavior. As such the approach defines a field of reference for geographers who use local environments to explain crime [4]. The eventual aim of such an analysis is multidisciplinary. Various applied studies conducted according to this approach

have already been published. Repetto [5] studied the displacement of crime and Sanders [6] recorded police reaction to criminal events and the utilization of computers to facilitate and geographically direct policing, whereas, Clarke and Hough [7] evaluated the effectiveness of police patrols. Taylor and McDonald [8] conducted a spatial analysis of crime in Dallas, Texas. Anderson [9] provided guide-lines for the planning and implementation of GIS for spatial crime analysis, and Wendelken [10] presented an overview of the application of GIS in the police services for a number of large American cities. GIS has a number of distinctive features well suited to the manipulation and analysis of geographical data. Its ability to analyze data of a spatial as well as a non-spatial nature, either separately or in an integrated manner [11]. GIS is a crucial elements for crime analysis and also the policing strategy [12]. Berry [13] summarizes the role of GIS in decision-making, which he reported as an understanding of the complex nature of spatial problems, which, in turn, could lead to effective decisions. The present research will assess the potential of Geographical Information Systems (GIS) for the analysis of crime pattern and its relationship with the road network in Karachi that would be beneficial for various crime agencies.

MATERIALS AND METHOD

The methodology of the study comprises into two phases, the first phase determines the general identification of hotspots developed through the periodic records of police data, by using the interpolation technique in GIS environment. The other segment do contain the survey, gathering of illustration

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in order to bring out the relationship of the snatching activities with the land use of a study area as well as to explore connection between criminal event in terms of snatching or robbery with the average number of pedestrians and the existing urban design environment, especially the road network. The second phase of the study determines the Geo spatial visualization of crime scene, which explains the process of 3-Dimensional visualization of crime scene for getting the better understanding of route design and help to minimize the criminal events by stick down the easiest escape route for the offender. The development of base map is through the high-resolution satellite image (QuickBird) data. While rest of the data is collected through field survey. In this study mostly the survey recorded result is formulated, crime record in terms of reported cases is obtained from CPLC and Sindh Police. Land use parcels, road network are the basic digitized themes while the Point of interest and crime event locators generated by the GPS coordinates. After getting the vector files the attribute information embedding is done while spatial join brings the new resultants of table. Field survey records are embedded with vector layers in order to perform the different multi weighted overlay analysis. The Geo-virtual environment (Figure 1) is created which consists of a 3D model, with perspective height, digital cadastral map and vector-based datasets including, administrative boundaries and others. Using GIS, all datasets are processed for 3D visualization. Afterwards the datasets are integrated into the Arc scene software. The 3-D surface is overlaid with other Geo-coded textures, 3-D routes determine the distant-access of crime scene to certain land use and the minimum and maximum distance of crime scene to the other locations, while the no of pedestrians (approx) are closest to such risk area. The geo-visual model is then compared KDE hotspots in contrast with the closest buildings with the hotspot regions. To enhance visual approach and to smooth the progress of further analysis, the minimum distance to the closest robbery and snatching scene is calculated for each building. Then building dataset is classified and coloured according to these minimum distance values, which allows exploring the buildings of urban environment closest to high number of robberies and snatching scenes. The other perspective is produced to explain the number of snatching scene closest to certain road or street segment. The higher the segments, the more robberies and snatching events are committed close to it. While the different shades of the segments represents pedestrian frequency.



Figure 1: 3-D perspective of the area showing the road geometry.

RESULTS AND DISCUSSION

The snatching activities are quite dominant in P.E.C.H.S. The created pinpoint (Figure 2) represents the major crime locations of the area. This map only shows the number of snatching events on certain street geometry. For better understanding, the event repetitions are noted and plotted (Figure 3) to find out the areas that are affected by such activities with greater frequency and to pinpoint the roads, which are playing a role as a smooth escape path for the offenders. Figure 4 highlights the roads, which are

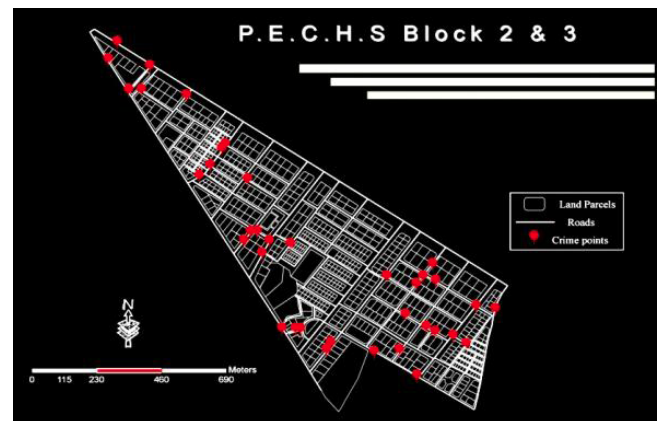


Figure 2: Crime Hot spots in the Study Area.

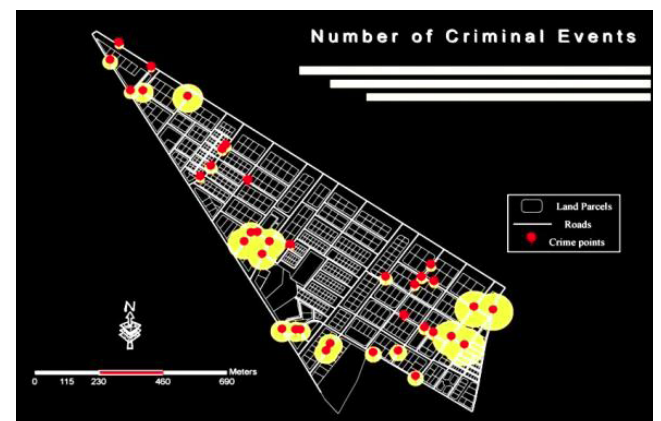


Figure 3: Spatial Distribution of Crime Events.

frequently affected by such snatching and robbery events, the study observed that most of the criminal events are near to the intersections of road arteries. The analysis also observe the criminal events and average number of pedestrian's correlation to find out that the populous streets are more affected or the others (Figure 5). The result reveal that mostly the streets with low pedestrian frequency has a greater ratio of risk for the snatching event while the private security and barrier concept reduces the risk of snatching in moderate and low frequency pedestrian areas.



Figure 4: Affected Road Network in the Study Area.

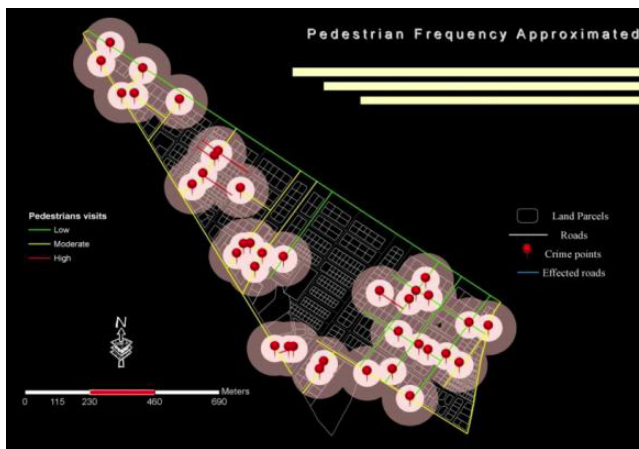


Figure 5: Frequency of Pedestrian Visits.

The Figure 6 shows the most effected land use category with the criminal incidents mostly the snatching sort of heads are found in the residential areas. The other heads like dacoity is having a mixed relationship with different categories of land use. The vacant areas that are serving as a parking lot for the vehicles are endangered with stealing of valuables from the vehicles. The snatching activity is mostly practice on the areas where easiest escape route is find mostly areas where there is no private security or barriers are available.

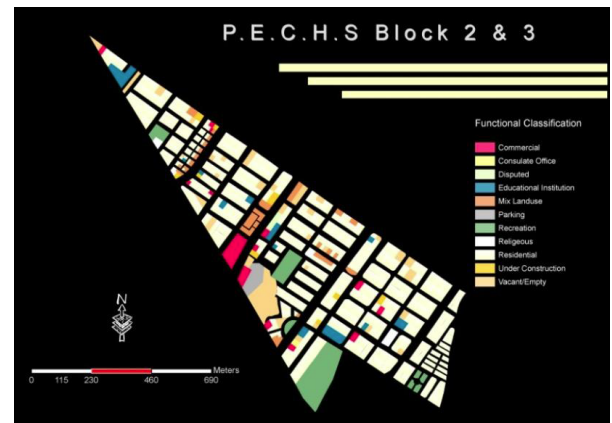
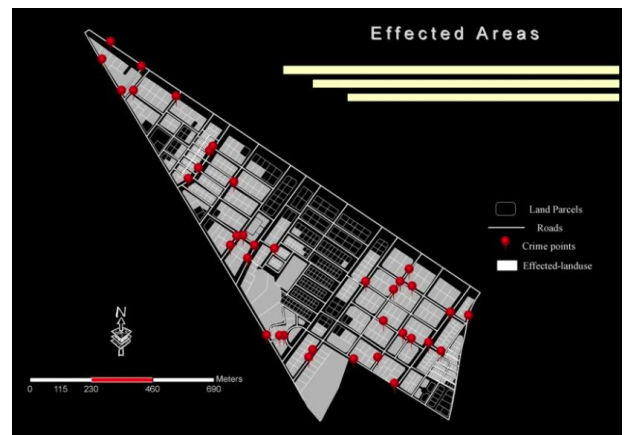


Figure 6: Affected Areas and Associated Land Use.

CONCLUSION

This study establishes the utility of GIS in the field of crime and provide the evidence of relation between the crime and the urban design environment in the road network. The intensity of few crime heads are most likely found near the some categories of urban land use while the road geometry and its design is also playing some part in adding or subtracting the criminal events. In this study, it is found that by coupling spatial clustering analysis with 3-D mapping technique most of the hidden factors are visualized. Flaws in road segments and urban design are easily pinpointed which are somehow responsible for increasing the crime rate in the city of Karachi. This study contributes in multiple sectors for security services such as the police force to adapt policing strategies according to the incidence of crime, for town planners and architects to create safe environments, and for sociologists and welfare services to neutralize the role of 'negative' environments in a social behavior.

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