

# **SafeR Mapping for Safe Refugee and Internally Displaced Persons (IDP) Relocation**

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## **ABSTRACT**

The study explores safe routing based on geographic danger scoring/mapping, specifically for use in conflict regions that produce internally displaced persons and refugees globally. This study takes inspiration from prior research on safe routes for cities, based on the extent of data available for such a use case. Estimating lower data availability, this research aims to introduce the creation of a new algorithm tailored specifically to make optimal use of the kind of data present.

Research has been conducted by analysing data of New Delhi, India [1], and New York City, USA [2], while aiming for a predictive estimation of danger rather than one based on the overall accumulation of crime.

The modern era faces multiple conflicts across the world, and many people are forcefully displaced. They have to relocate within borders as Internally Displaced Persons (IDPs) or escape their countries as Refugees. Some examples include the Syrian Civil War, Myanmar's Rohingya Crisis, and the recent Russia-Ukraine War. While the algorithm may not be easily accessible for most individuals in such regions, with further development, it may be of especially great benefit to aid camps and organisations working in the region such as the United Nations, Doctors Without Borders, Red Cross, etc. who can directly be provided with the application.

They may use the application to suggest routes to those migrating, as well as for their own safety such as during the movement of personnel/resources, and even to decide the best locations for the establishment of camps.

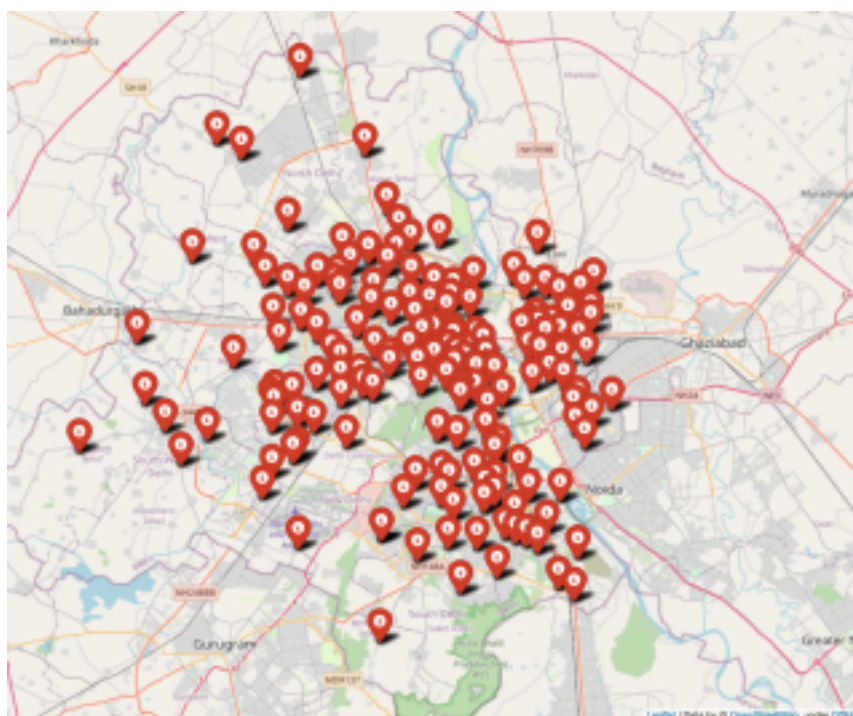
## **INTRODUCTION**

According to the Office of the United Nations High Commissioner for Refugees (UNHCR), there exist over 103 million forcibly displaced people across the globe, 72% of whom originate from just 5 countries [3].

During migration, they often have to trust unreliable sources to obtain information and aid. They

face multiple dangers amidst the conflict, and a lack of medical assistance and food supply. Over 4000 asylum seekers lose their lives annually, during this process. There is a need to guide them in this process and ensure contact with existing aid camps in the area.

Though largely limited, there has been some prior research on the detection of safe routes [4]. However, this research has been conducted primarily for cities, with the assumption of high levels of constantly updating data. After conducting our own analysis of the refugee situation globally, detailed in a collaborative whitepaper [5], there is great opportunity for such a mapping system to be used in conflict locations where even the slightest of differences in danger levels can be a matter of life and death. Such conflict areas will in most cases not have data as readily available or updated as cities, due to other governmental priorities or instabilities. Though this limits the accuracy of danger scoring for safe route prediction, an algorithm can still be created to make optimal use of the data that may be available. In this paper, this objective is pursued by making a prediction of the danger score based on past annual danger trends rather than an overall accumulation of all crimes in a set time period. Detailed over the remaining paper using Delhi data, the region is divided into smaller segments and given individual scores based on the coefficient/weightage given for each crime as well as how recently it occurred. The regional scores are used to find total route danger levels and pick the safest of all available routes. This serves as a mapping application for refugees that takes danger into consideration rather than just distance and estimated time.



*The New Delhi, India crime datapoints plotted have been used for the methodology that follows.*

## **METHODOLOGY**

## **Aim of the study**

To create an algorithm that makes the best use of available data, to calculate danger scores for regions in a map and considers them to find the safest route.

## **Research Design**

Building and explaining a new algorithm

## **Consent and Ethical Issues**

All ethical considerations were followed for the current study. All data utilised was taken datasets readily available in the public domain, specifically for such research. All crime datapoints include only the type of crime and approximate location, without procuring any information of the victims of the crime.

## **Sample**

A sample of 3361 crimes in various parts of Delhi, India [1] have been used for building the algorithm. The data has been cleaned such that each datapoint include the coordinates for the location where the crime occurred, the type of crime (divided into murder, rape, robbery, and theft), the quantity of each such crime, and the year it occurred.

Static, limited data has been used to replicate a comparatively low availability of data in conflict locations, so the algorithm can be readily repurposed.

## **Algorithm**

### **a. Region Classifier**

Data is divided based on when each crime took place and its location.

Based on the coordinates available, the dataset is divided into small regions of area 1 km<sup>2</sup> each. Each region is given an annual danger score based on the process that follows.

### **b. Danger Scoring**

The annual crime data points that lie within each region are weighted by intensity of crime considered to reach the annual danger score  $D_{[lat, long]}$

$$D_{[lat, long]} = \sum [K_i * n(C_i)]$$

$K_i$  = Crime Weight (Based on prison terms for relative intensity of each crime)

$C_i$  = Each type of crime lying within [lat, long]

Crime	Weight
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Murder	14
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Rape	7
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Robbery	5
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Theft	0.5
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*\*A few such examples are visible in the above table. These have been assumed with thorough analysis based on minimum sentences for each crime type according to the Indian Penal Code and can always be refined further with additional research.*

### c. Utilising Annual Scores

Once we have an annual score for each region, they are all considered in finding a final score that will be used to choose the safest route.

This is implemented by providing a weight to each year's score and taking their sum. For the dataset we have worked on, the following years and weights have been used.

Year	Weight
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2017	1
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2018	2
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2019	3
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2020	4
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2021	5
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*More recent years are given a higher weight, to reach a more accurate current crime score. An older crime may not be as indicative of the crime levels in an area as more recent crimes.*

### d. Route Detection (Future Scope)

All possible routes on the google maps API from one location to another are considered and each route is given a total score  $R_i$ .

This is done by considering each region touched/crossed by the route. Each individual region's final score is multiplied with the meter distance travelled within it. The value all such regions are summed up for a route score.

$$R_i = \sum (\text{region crossed} * \text{distance of route within region})$$

*The Route with the lowest score is displayed.*

## RESULTS

Region	Bottom-Left Coordinates Top-Right Coordinates		Final Danger Score
	Latitude	Longitude Latitude Longitude	
lat14_long0	28.592102 04 2613995	76.91555 28.60114575 76.92343256 9943567 063715	5685
lat18_long6	28.628276 91 193228	76.96284536 28.63732062 76.97072792 382292 926185 446008	9835
lat23_long7	28.673495 49 8580134	76.97072792 28.68253921 76.97861048 446008 5909706 509724	12255
lat8_long34	28.537839 73 8636567	77.18355706 28.54688345 77.19143962 166328 596614 230044	17185
lat41_long3 9 (e.g. high danger zone)	28.836282 41 0512418	77.22296986 28.84532612 77.23085242 484905 7841986 54862	418435
...			

*The table represents examples of the total 1680 sq km regions that Delhi has been divided into, marked by the coordinates of their bottom-left and top-right corners. Each region has been given a score using the algorithm detailed in the paper, adding weightage to the type and year of the crime committed. For example, the region labelled “lat41\_long39” has a much higher danger score and can statistically be considered a “high danger zone”*

## DISCUSSION

The utilised data has thus been used to calculate smaller regional scores for a conflict location which can be utilised for safer route detection when data is limited. The regional scoring can now provide scores to the available routes from point A to B, for final route detection.

## **CONCLUSION**

A highlight on using limited data for safe route detection in conflict locations, where it's most impactful, also makes way for the future use of data extracted from online media and reports in the algorithm. While the accuracy of the recommendation is directly proportional to the amount of data available, this paper serves as a stepping stone to highlighting the need for greater research with a focus on danger levels in conflict locations, such that the comparatively limited data is used in the best manner possible.

## **LIMITATIONS**

- (i) In the current study, multiple square kilometre regions remain unscored due to a lack of available data, which is in progress of being addressed through communication and crime statistics request to the Delhi Government based on the Right to Information Act, 2005.
- (ii) At large, the mapping of danger zones for safe route recommendations reveals the possibility for bias or the marking of specific communities as "high danger zones".
- (iii) There is also scope for improvement in the coefficients or "weights" for the year in which each crime occurred, to output more accurate danger zones, which take better account of how recent each crime is.
- (iv) We can use data spanned out across multiple years for long ongoing conflict, but the danger scoring cannot account for rapid developments in conflict. This can be improved by further research on events correlated to the trends in crime, but the model can never provide a near-absolute estimation of danger in a constantly evolving situation.

Therefore, this paper serves simply as an introduction to SafeR's plan for further development of the algorithm. We've begun work with international aid organisations on directly studying conflict regions with their support and past data. We also plan to expand on the usage of web scraping articles and reports for the use in the safe routing algorithm as well as adopt past work on the use of satellite imaging [6]. Given the risk involved with the usage of the algorithm for Refugee and IDP relocation, we have no intention of releasing the platform until developed to a much greater extent with exhaustive testing and mentorship.

## **ACKNOWLEDGEMENT**

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## REFERENCES

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