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Women Safety Risk Zone Prediction System

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Academic Year: 2025-2026

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INTRODUCTION

➔ Overview of the project:

- The project focuses on women's safety using **crime data analysis.**
- It comes under **Data Analytics** and **Web-Based Visualization**.
- It uses **location-based** data to identify unsafe areas.

➔ Importance and motivation of the selected problem:

- Often women feel **unsafe** while travelling alone, and they are often **unaware** of the high risk areas.
- Hence, there is a need for a system that helps identify unsafe zones in advance.
- We aim at building a project that makes women feel **more secure** around their surroundings, as this is an issue that women face on a frequent basis.

PROBLEM STATEMENT

"Women often face uncertainty and safety concerns while traveling, particularly due to the ***lack of clear awareness about high-risk areas*** *within a city. Although crime data is recorded, it is not presented in a* ***structured, location/time-specific, and easily understandable format*** *that supports preventive action. This limitation creates a strong need for a* ***data-driven system*** *that can identify and* ***visually represent risk zones*** *to enhance safety awareness and informed decision-making."*

OBJECTIVES

- To analyze **crime datasets** related to women safety
- To design a **risk scoring mechanism**
- To implement **heatmap visualization** using geospatial data
- To perform **time-based** risk analysis
- To develop a **web-based** dashboard using Flask
- To provide **explainable insights** for risk levels

LITERATURE SURVEY

S.No	Topic Name	Author(s) (Year)	Description	Limitation
1	Crime Mapping Against Women in Jaipur City	Mahendra Kumar Boss & Monika Kannan (2024)	GIS-based spatial analysis to identify crime clusters related to women's safety.	Focuses mainly on spatial mapping; *lacks time-based trend analysis* and *interactive decision-support features.*
2	Using Heat Maps to Identify Areas Prone to Violence Against Women	Margarita Garfias Royo, Priti Parikh, Jyoti Belur (2020)	Uses heatmap visualization to identify high-risk areas for violence against women.	Provides density visualization only; does not include *predictive modeling or risk scoring mechanisms.*
3	Crime Hotspot Mapping Using Crime-Related Factors: A Spatial Data Mining Approach	Dawei Wang, Wei Ding, Henry Lo, et al. (2013)	Applies spatial data mining techniques for crime hotspot detection.	Technically complex and research-oriented; *lacks user-friendly implementation* for public awareness.

S.No	Topic Name	Author(s) (Year)	Description	Limitation
4	Comparative Study of Approaches for Detecting Crime Hotspots	Zhanjun He, Rongqi Lai, et al. (2022)	Compares different statistical and spatial methods for hotspot detection.	Focuses on method comparison; does not propose a *practical deployment system.*
5	Crime Hotspot Detection and Monitoring Using Video Event Modeling	Zou Beiji, Nurudeen Mohammed, et al. (2017)	Integrates video analytics and spatial monitoring for crime detection.	Requires surveillance infrastructure and high implementation cost; not *specifically focused on women safety.*

PROPOSED SYSTEM

➔ The proposed system is a ***data-driven web application*** designed to identify, analyze, and visualize high-risk areas affecting women's safety. It transforms raw crime data into meaningful safety insights using spatial mapping, time-based analysis, and risk scoring.

➔ **Key Features:**

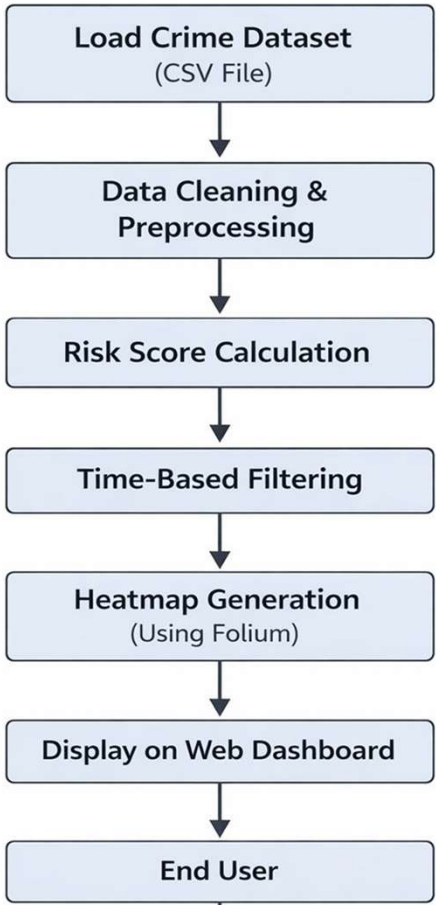
- Risk Zone Prediction
- Heatmap Visualization
- Time-Based Risk Analysis
- Trend Detection
- Safety Score Assignment

➔ **Advantages over other system**:

- Unlike static spatial maps, the system includes **time-based trend detection**.
- Unlike density-only heatmaps, it includes **risk scoring and structured analysis**.

SYSTEM ARCHITECTURE/METHODOLOGY

- The system follows a structured pipeline starting from data collection to final user visualization, ensuring smooth data flow and organized processing.
- The architecture is designed to convert **raw crime data** into **meaningful safety insights** that support awareness and informed decision-making.


Load Crime Dataset
(CSV File)
Data Cleaning & Preprocessing
Risk Score Calculation
Time-Based Filtering
Heatmap Generation
(Using Folium)
Display on Web Dashboard
End User

TECHNOLOGIES & TOOLS USED

- **Programming Language:** Python
- **Framework:** Flask
- **Libraries:**
  - Pandas(DataProcessing)
  - NumPy(Numerical Operations)
  - Matplotlib & Seaborn (Visualization)
  - Folium (Heatmap Mapping)
- **Platform:** Visual Studio Code
- **Tools:** GitHub
- **Dataset:** Dummy dataset

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STAKEHOLDER SURVEY - OVERVIEW

- A survey was conducted to understand safety concerns faced by women during daily travel.
- Stakeholders included **female students** and **working women**, especially those traveling during evening and night hours.
- A discussion was held with the **Women Empowerment Cell**, and **Ms.Sneha Grace Thomas** [Co-Head of Women Empowerment cell,Saintgits College of Engineering] was selected as the ***project stakeholder***.
- Feedback highlighted the need for:

  -Clear identification of unsafe zones

  -Time-based risk awareness

  -An easy-to-use safety visualization system

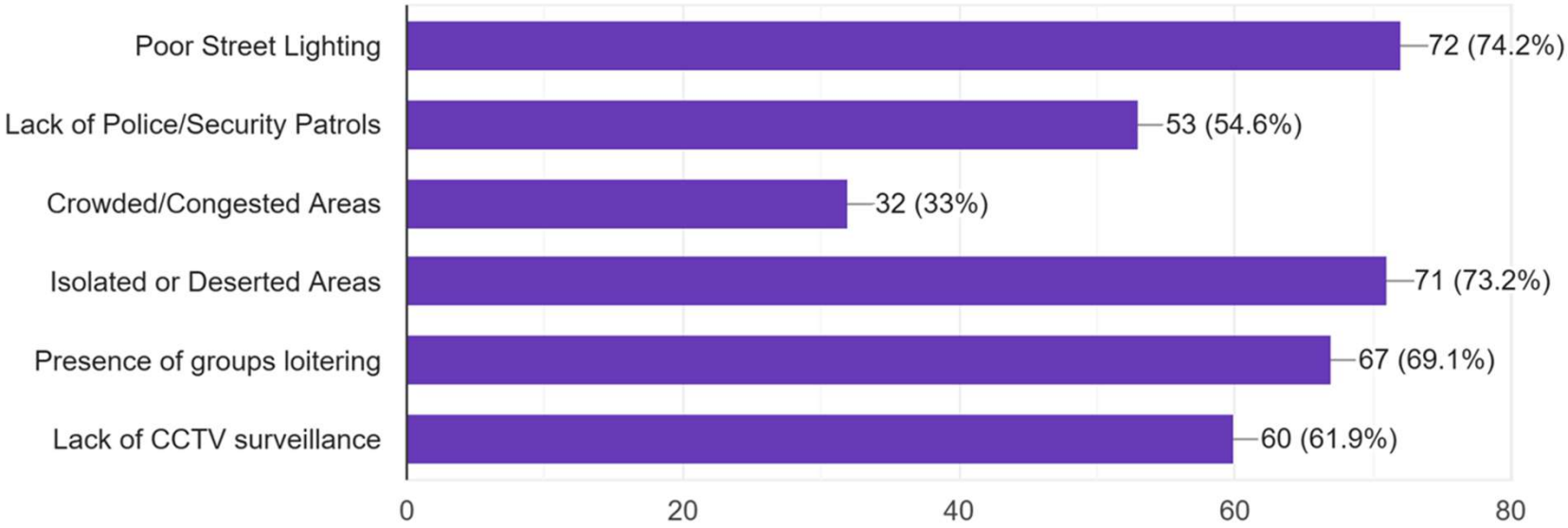
SURVEY METHODOLOGY

- **Survey Type:** Online Questionnaire
- **Tool Used:** Google Forms
- **Number of Respondents:** 95+
- **Survey Duration:** 25 days

KEY SURVEY FINDINGS

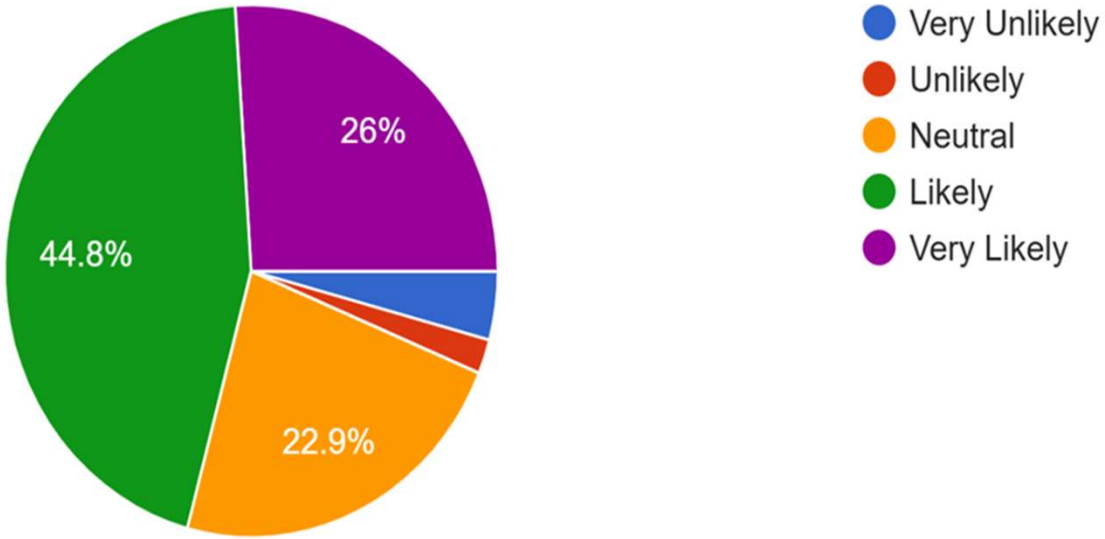
Which of the following factors, in your opinion, contribute most to making a public area feel unsafe? (Select all that apply)

97 responses



If an AI system could predict high-risk zones, how likely would you be to adjust your route or travel time based on its warning?

96 responses



PROBLEM IDENTIFICATION FROM SURVEY

- Majority of respondents identified **poor street lighting and isolated areas** as major safety risks.
- Many participants feel unsafe during **night travel (9 PM – 3 AM)**.
- Respondents emphasized the need for **clear identification of why a location is risky** and providing **alternate safe routes**.
- Users want a system that provides **real-time risk awareness and insights,** not just static maps.
- Need for **visual representation of unsafe zones** for better understanding.

*Based on the survey findings the problem statement was finalized to focus on a **location-specific** and **time-based safety prediction system** that helps women identify and avoid high-risk areas within the city.*

WORKS COMPLETED SO FAR

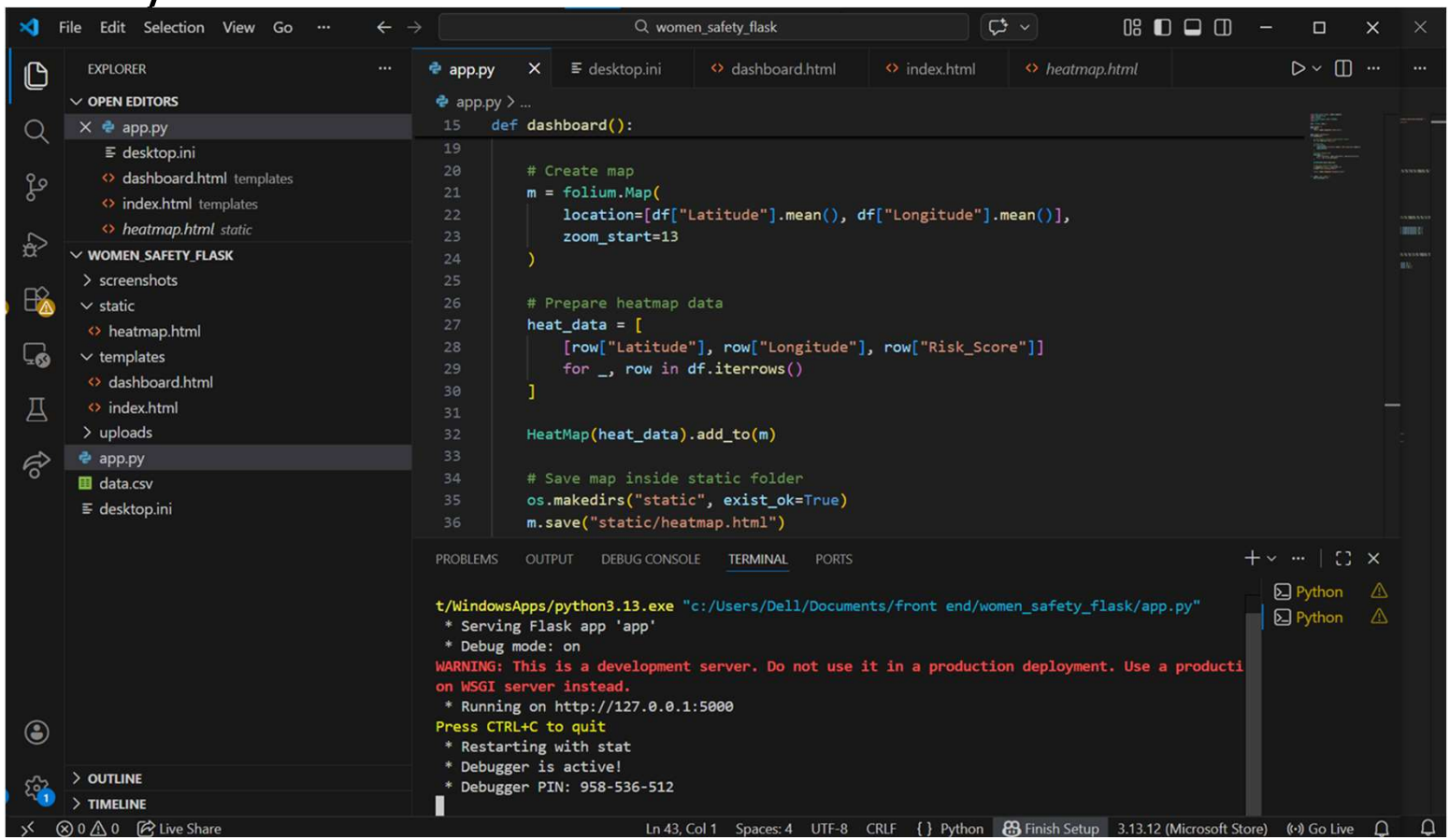
- ✓ Problem identification
- ✓ Requirement analysis
- ✓ Literature survey completed
- ✓ System design finalized
- ✓ Demo heatmap implemented
- ✓ Flask web interface developed
- ✓ Basic risk scoring model implemented

INDIVIDUAL CONTRIBUTIONS

- **Liz Mary:** Worked on understanding the real-world safety issues and defining the problem scope. Helped identify key system requirements and explored potential data sources. Contributed to refining the problem statement.
- **Neha Ann:** Designed the overall system workflow and planned core features such as risk prediction and time-based analysis. Structured how the safety score and explainable insights will be implemented.
- **Neha Merin:** Developed the basic Flask web structure and created the initial UI layout. Integrated a demo heatmap visualization and worked on improving the user interface design.
- **Sara Elena:** Prepared documentation including literature review and system diagrams. Designed presentation slides and managed the GitHub repository structure.

Stakeholder Discussion (Group Work): As a team, we conducted discussions with the Women Empowerment Cell and finalized Sneha Miss as our stakeholder. Her inputs helped us refine the system objectives and focus areas.

RESULTS/SCREENSHOTS



Women Safety Risk Zone Prediction

Data-driven approach to identify unsafe areas

Project Overview

Women's safety requires proactive, data-driven solutions rather than reactive measures. This system analyzes crime data, location information and time-based patterns to identify unsafe areas in India. It assigns safety scores and visualizes risk zones using heatmaps.

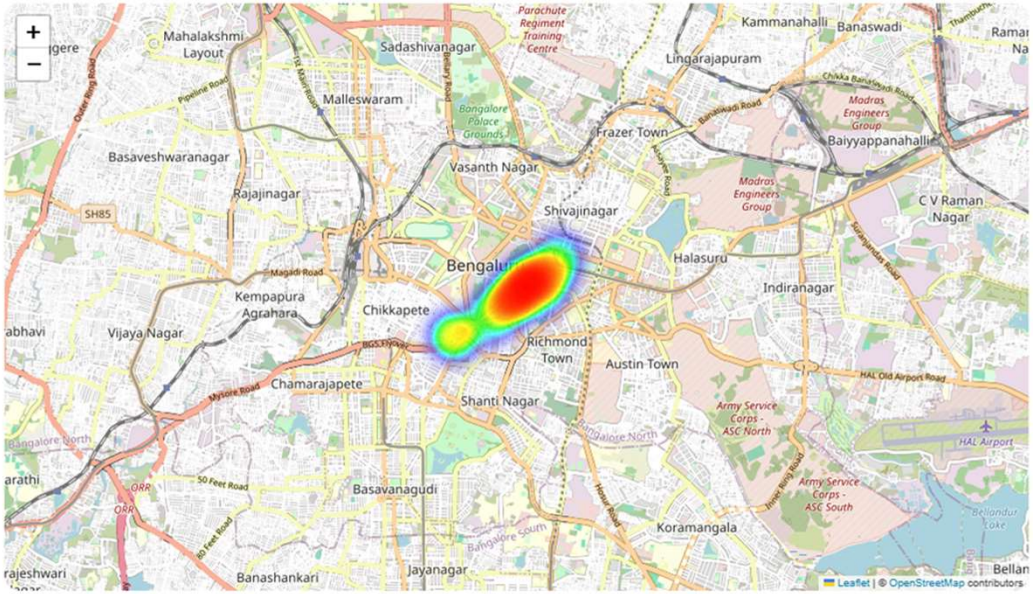
Core Features

- Risk Zone Prediction
- Heatmap Visualization
- Time-Based Risk Analysis
- Safety Score for Areas
- Explainable Risk Factors
- Trend Detection

View Risk Heatmap

Women Safety Risk Zones

Heatmap visualization of unsafe areas



Low Risk Medium Risk High Risk

CHALLENGES AND FUTURE WORK

- Difficulty in obtaining authentic, city-level crime data specifically related to crimes against women. Currently coordinating with police officials to access reliable and verified data, which is a time-consuming process.

- In the next phase, we plan to **integrate** verified and authentic crime data from official sources to improve reliability. We aim to **strengthen the risk prediction logic** and refine time-based analysis for better accuracy. Additionally, we **will enhance the safe route** feature and focus on **providing alternative routes** features based on risk scores with **explainable insights**. We also aim at improving the overall user interface for a smoother and more **practical user experience.**

CONCLUSION

Summary of Work Completed

- Defined the problem through **survey and stakeholder discussions**.
- **Designed system workflow** and planned **core features**.
- Developed a basic demo website with **heatmap visualization**.

Expected Outcome

- A system that visually identifies high-risk areas.
- Time-based safety insights for better awareness.

Scope for Future Enhancement

- Integration of authentic crime data.
- Improved risk prediction accuracy and enhanced user interface and features.
- Include features like alternative safe routes with integration of Explainable AI.

REFERENCE

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Survey Findings:

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