CrimeLens

Crime Pattern Prediction and Visualization Platform

Guide :

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Team Members :

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69 - Phoenix Lal P T

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Problem Definition

- **The Data Chasm:** The fundamental issue across many domains, from urban planning to law enforcement, is the vast chasm between acquiring large volumes of raw data and deriving timely, actionable intelligence from it.

- **Complexity Overload:** Traditional, static analytical methods are often overwhelmed by complexity, preventing organizations from making proactive, data-informed decisions.

- **Fragmented Public Safety Tools:** Most existing platforms are reactive, showing only historical data without providing real-time sentiment, 3D spatial depth, or intelligent navigation for citizens.

- **Absence of Actionable Context:** Static maps lack personalized safety advice grounded in local crime patterns, leaving a gap in immediate, context-aware safety guidance.

Objectives

1. Advanced Crime Analysis and Hotspot Detection

Develop an advanced crime analysis platform that identifies hotspots, spatial clusters, and temporal trends using optimized K-means clustering and machine learning techniques. This supports data-driven decision-making for law enforcement and policymakers by pinpointing areas of high crime concentration from filtered historical datasets.

2. High-Performance Geospatial Visualization and Interactive Dashboards

Empower users with high-performance visualization tools, moving from traditional 2D heatmaps to immersive 3D density maps using Hexbin layers and extrusions powered by Deck.gl and MapLibre. These interactive dashboards highlight localized risks and provide a clear visual hierarchy of crime intensity across urban environments.

Objectives

3. AI-Driven Predictive Modeling and Proactive Insights

Leverage machine learning to transition from reactive to proactive safety by integrating XGBoost classifiers for severity prediction and Facebook Prophet for 12-month future crime volume forecasting. This enables users to anticipate potential risks and resource needs based on sophisticated temporal and geospatial feature analysis.

4. Conversational Safety Guidance and Real-Time Sentiment Intelligence

Bridge the gap between complex technical data and citizen safety through a conversational AI Safety Assistant powered by Google Gemini that provides context-aware advice. Furthermore, implement a Public Perception Engine that uses NLP to analyze local news headlines, generating a real-time Fear Index to gauge community sentiment.

Objectives

5. Crowdsourced Intelligence and Automated Professional Reporting

Facilitate community engagement through a User Crime Reporting tool that allows crowdsourced incident pins to be dropped directly onto the interactive map. Additionally, streamline administrative workflows with a one-click PDF export system that summarizes findings using AI, providing professional-grade intelligence reports inclusive of maps, trends, and localized risks.

Literature Survey

SI NO.	TITLE	OBSERVATIONS
1	**Crime Prediction Using Machine Learning and Deep Learning: A Systematic Review and Future Directions**	• Summarizes commonly used ML/DL algorithms and public crime datasets for spatial and temporal analysis. • Highlights integration of multi-source data (demographics, weather, social media, surveillance). • Discusses major limitations including data quality, interpretability, bias, privacy, and ethical issues. • Identifies future research directions for scalable, interpretable, and real-world crime prediction systems.
2	**Artificial Intelligence in Crime Prediction: A Survey With a Focus on Explainability**	• Emphasizes the importance of Explainable AI (XAI) for transparency, trust, and ethical policing. • Identifies that XAI integration is still limited, highlighting gaps in interpretability and fairness. • Suggests future directions toward trustworthy, transparent, and ethical AI-driven crime prediction systems.

Literature Survey

SI NO.	TITLE	OBSERVATIONS
3	**CAMELON: A System for Crime Metadata Extraction and Spatiotemporal Visualization From Online News Articles**	• Proposes an intelligent crime monitoring system that mines large-scale online news articles for crime analysis. • Uses deep learning cross-lingual models for crime-type classification and detailed crime metadata extraction. • Enables interactive spatiotemporal visualization to support law enforcement, policymakers, and public users. • Demonstrates good performance and usability, showing potential for generalized, real-world deployment.
4	**Crime Reporting and Victim Satisfaction with the Police: A Large-Scale Study in the Netherlands**	• Analyzes a nationwide survey of 25,760 crime victims to study satisfaction with police services after crime reporting. • Finds that reporting channel and police response (follow-up contact and further action) have the strongest impact on victim satisfaction. • Shows that in-person and phone reporting lead to higher satisfaction than online reporting, highlighting the importance of human interaction.

Literature Survey

SI NO.	TITLE	OBSERVATIONS
5	**Hierarchical Multi-Class and Multi-Label Text Classification for Crime Report: A Traditional Machine Learning Approach**	• Applies data mining and machine learning algorithms to analyze historical crime data and identify hidden crime patterns. • Demonstrates that classification and clustering techniques improve crime trend prediction and hotspot identification. • Highlights the usefulness of predictive analytics in supporting proactive policing and crime prevention strategies.
6	**A Comparative Analysis of Multiple Methods for Predicting a Specific Type of Crime in the City of Chicago**	• Compares multiple machine learning models (Logistic Regression, SVM, KNN, Random Forest, XGBoost) for predicting theft crimes using spatiotemporal data. • Demonstrates that XGBoost achieves the best performance with an F1-score of 0.86, showing effectiveness for structured crime data. • Highlights the importance of spatial and temporal features and uses SHAP-based explainability to improve model transparency.

Literature Survey

SI NO.	TITLE	OBSERVATIONS
7	SafeRoute: Learning to Navigate Streets Safely in an Urban Environment	• Proposes a reinforcement learning–based routing system that prioritizes safety over shortest distance in urban navigation. • Integrates crime statistics and environmental features to learn safer paths through city streets. • Demonstrates that safety-aware routes can significantly reduce exposure to high-crime areas with minimal increase in travel distance.
8	Better safe than sorry: a vehicular traffic re-routing based on traffic conditions and public safety issues	• Integrates official criminal statistics and crowd-sourced data to evaluate road risk alongside real-time traffic speeds. • Uses a non-deterministic Pareto algorithm to ensure vehicles avoid high-risk areas without creating new congestion, improving individual safety for 60% of drivers compared to standard navigation.

Literature Survey

SI NO.	TITLE	OBSERVATIONS
9	Analysis of news sentiments using natural language processing and deep learning	• Uses Long Short-Term Memory (LSTM) networks to analyze news context, as they can "remember" word sequences better than standard neural networks. • Accuracy peaked at 58%, performing only slightly better than a random guess and highlighting the extreme unpredictability of stock movements
10	London street crime analysis and prediction using crowdsourced dataset	• Merges police records with crowdsourced metrics like station proximity, schools, and unemployment to identify crime catalysts. • Features a cross-platform mobile/watch application for real-time safety reporting and victim-perspective data collection. • XGBoost Regression outperformed other models, achieving a 76% R2 score for predicting crime counts over a two-week period.

Novelty / Overall Contribution

- **Unified Multi-Source Intelligence Framework** The platform bridges the "data chasm" by integrating disparate data streams—including historical crime records, geospatial coordinates, and qualitative news sentiment—into a single, real-time analytical hub. This prevents data silos and provides a comprehensive view of urban safety.

- **High-Dimensional 3D Geospatial Visualization** Moving beyond traditional flat mapping, the project utilizes 3D Hexbin layers with vertical extrusions. This translates raw crime density into a visual hierarchy of risk, allowing users to intuitively grasp the magnitude and intensity of hotspots through spatial depth.

Novelty / Overall Contribution

- **Hybrid Predictive Analytics Architecture** The system implements a dual-tier modeling stack: XGBoost for event-based severity classification and Facebook Prophet for longitudinal volume forecasting. This enables a shift from reactive incident response to proactive threat anticipation and resource optimization.

- **Socio-Technical Public Safety Ecosystem** The project introduces a human-centric dimension to analytics by aligning objective statistics with subjective community perception via an NLP-powered "Fear Index." This is augmented by generative AI safety guidance to support data-driven decision-making for both citizens and authorities.

Sustainable Development Goals

SDG 11 – Sustainable Cities & Communities

- Improves public safety
- Helps reduce crime impact
- Supports smart city planning

SDG 16 – Peace, Justice & Strong Institutions

- Enables data-driven policing
- Enhances transparency
- Improves law enforcement response

SDG 9 – Industry, Innovation & Infrastructure

- Uses AI and data analytics
- Promotes smart digital infrastructure

Task Distribution

Rajeev R

- Frontend development (React)
- Interactive dashboard UI
- Data visualization (charts, maps)
- 3D geospatial layer implementation
- Dashboard logic

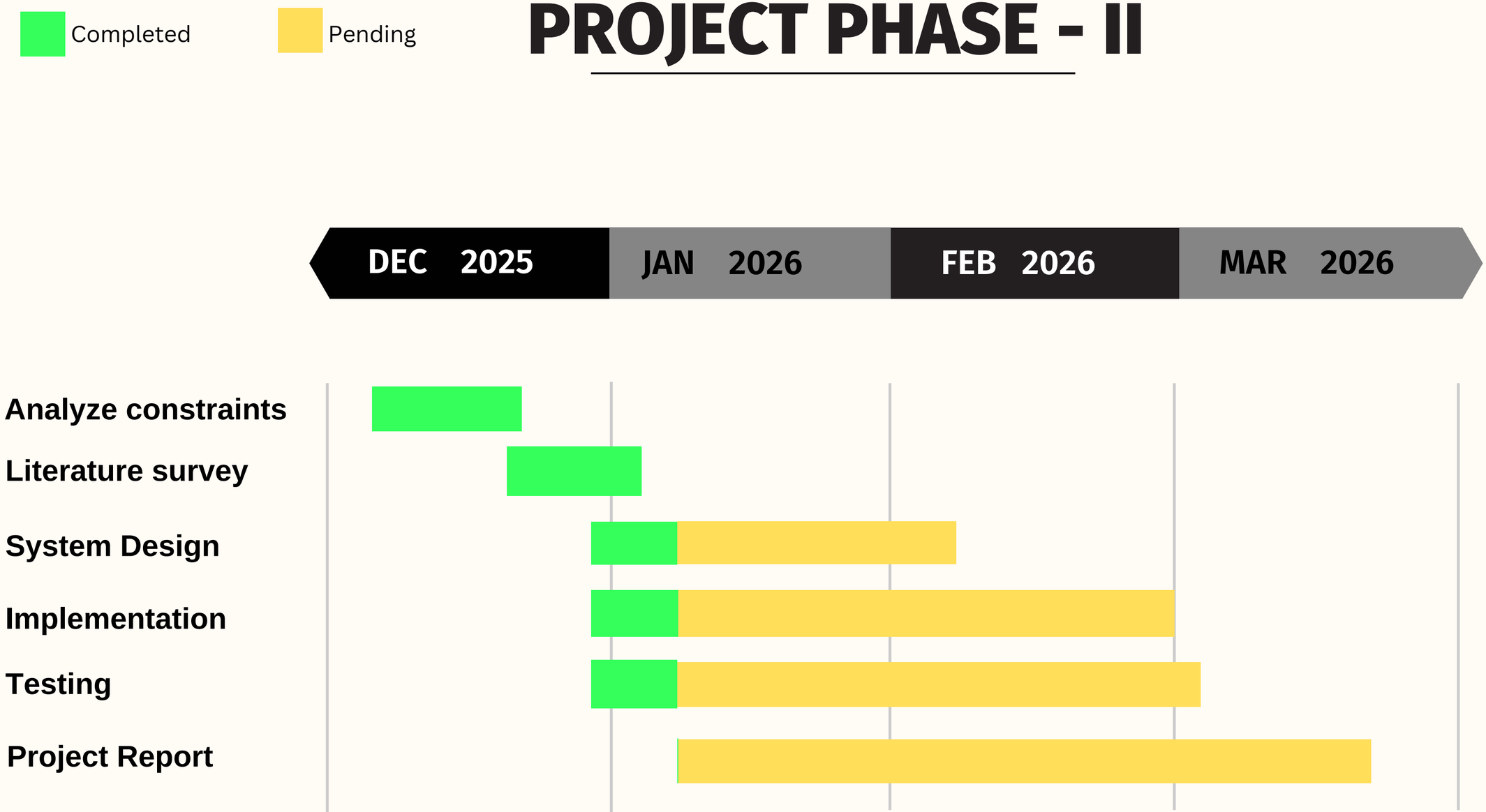
Vaisakh V

- Backend development (FastAPI)
- Crime prediction model (XGBoost)
- API integration
- Time-series forecasting

Phoenix Lal P T

- Backend development (FastAPI)
- Data preprocessing
- API integration
- Sentiment analysis module

PROJECT PHASE - II



Conclusion

CrimeLens represents a strategic evolution in urban safety, transitioning from a foundational analytical framework into an integrated, multi-source intelligence ecosystem. By building upon robust machine learning pipelines, the platform is designed to bridge the gap between raw data and actionable community safety through high-fidelity 3D geospatial visualization and real-time sentiment intelligence. By integrating high-performance mapping technologies and NLP-driven perception analysis, the system moves beyond static metrics to offer a proactive tool for data-informed risk mitigation in modern smart cities.

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THANK YOU