INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 05, Issue 09, September 2025, pp : 15-20

www.ijprems.com
editor@ijprems.com

e-ISSN : 2583-1062
Impact Factor : 7.001

SAFECITY INSIGHTS

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DOI: https://www.doi.org/10.58257/IJPREMS43656

ABSTRACT

In today's fast-moving digital world, the fight against crime is no longer limited to traditional policing methods. Alongside detectives and officers, experts in technology and data analysis are now playing a growing role in solving and even preventing crimes. This shift highlights the evolving partnership between criminology a long-established field focused on understanding criminal behavior and modern data-driven tools. Criminologists offer valuable insights into why crimes happen, while technologies like data mining and predictive policing help law enforcement identify patterns, track suspects, and anticipate criminal activity before it occurs. This blend of human understanding and technological innovation is changing the way we approach public safety. By exploring the roots of criminology and the impact of digital tools in law enforcement, this paper looks at how modern crime-solving is becoming faster, smarter, and more proactive than ever before.

1. INTRODUCTION

Crime-solving has always been seen as the job of police officers, detectives, and others working in the criminal justice system. But in today's digital world, things are changing. With the rise of new technology, experts in computer science and data analysis are becoming key players in helping law enforcement. By using advanced tools and data techniques, they can help track down criminals faster and make investigations more efficient.

At the heart of understanding crime is criminology the study of crime, why it happens, and how society responds to it. Criminologists look at patterns, behaviors, and social factors that influence criminal activity. Their insights help build profiles of offenders, spot trends, and even predict where or when crimes might happen. This kind of knowledge is essential, not just for solving crimes, but for preventing them in the first place.

Criminology isn't new. It's been around since the 1800s, helping us understand the deeper causes of crime and how best to respond to it. And let's face it crime affects all of us. It damages communities, causes fear, and places a big burden on society. That's why it's so important to keep finding better ways to fight it.

2. LITERATURE SURVEY

Many recent studies highlight how modern artificial intelligence (AI) and machine learning (ML) techniques are being used to detect and prevent crime especially at the neighborhood level. This growing body of work not only pushes forward what we know in the field, but also tackles one of the biggest challenges researchers face: the lack of accessible, relevant datasets. To help fill this gap, this research brings together and catalogs a range of publicly available datasets used in previous studies, making it easier for future researchers to build on existing work.

Across the literature, the methods and applications for crime prediction vary widely, depending on the specific goals and scope of each study. More recent surveys have taken a broader approach by including a wide range of contributing factors like socioeconomic conditions, patterns in time and space, demographics, and even geographic features. A good example is the dataset introduced by Bellarmine (2018), which combines crime statistics with local neighborhood data such as unemployment rates, household incomes, and population density. These more detailed, multi-layered datasets help create predictive models that are more accurate and reliable.

One area where deep learning has made a real impact is in computer vision and video analysis. These technologies are now being used to analyze surveillance footage in real time, automatically identifying incidents like assaults, robberies, or harassment. Beyond video, crime-related data from sources like police reports and even social media is being processed with machine learning tools, offering a more complete and nuanced picture of criminal behavior.

Several key studies have made notable contributions in this space. For example, Zhao and Tang (2018) offered a broad overview of crime analytics in urban settings, blending criminology theory with practical algorithmic solutions. Saravanan et al. (2021) focused on data mining techniques applied to crime-related variables, while Kawthalkar et al. (2020) took a closer look at crime prediction tools for smart cities, comparing the strengths and weaknesses of existing approaches. These authors all pointed out that while many promising ideas have been proposed, there's still a need to

test them more thoroughly in real-world settings. Shamsuddin et al. (2017) offered a concise summary of current methods and highlighted where future improvements could be made. Meanwhile, Fredrick David KR and colleagues (2017) examined both supervised and unsupervised learning methods for detecting and predicting criminal behavior.

To guide this review, the research uses the Systematic Literature Review (SLR) framework proposed by Kitchenham and Charters (2007). This method follows a clear, structured process with three main phases: planning, conducting, and reporting. It helps ensure that the review is thorough, transparent, and easy for others to replicate.

3. METHODOLOGY

1. Problem Definition

The primary objective of this research is to predict and analyze crime patterns across spatial and temporal dimensions. This involves three key tasks:

- **Crime Classification** – Determining whether a crime will occur within a specific region and time frame (binary or multiclass).
- **Crime Count Prediction** – Estimating the number of incidents expected in a given area during a defined time window.
- **Hotspot Detection** – Identifying regions with high crime density (hotspots) and distinguishing them from low-crime areas (cold spots).

To achieve accurate predictions, it is crucial to decide on the spatial unit (e.g., 500m × 500m grids or police beats) and the time intervals (hourly, daily, weekly) for analysis.

2. Data Acquisition

The next step is gathering data from multiple reliable sources, such as:

- **Police records** including FIR and incident logs.
- **Emergency call logs** (100/112).
- **Geospatial data** like administrative boundaries, roads, and points of interest (POIs).
- **Demographic details** from census reports.
- **External factors** such as weather conditions, festivals, and public events.

A sample dataset structure may include fields like incident ID, timestamp, geographic coordinates, crime type, beat ID, victim information, and weapon usage indicators.

3. Data Preprocessing

The raw data must be cleaned and standardized before model development. This process involves:

- Removing null or invalid entries and correcting inconsistent data types.
- Deduplicating incidents to avoid redundancy.
- Geocoding locations and mapping them to the correct spatial units.
- Handling anomalies such as incorrect coordinates or unrealistic timestamps.
- Scaling numerical variables for algorithms like SVM and K-NN.
- Splitting data into training, validation, and test sets using a **time-aware strategy** (e.g., earlier years for training, recent data for testing) to prevent data leakage.

4. Exploratory Data Analysis (EDA)

EDA helps uncover patterns and trends in the dataset, including:

- **Temporal analysis** – Identifying peak crime hours, days, and seasonal variations.
- **Spatial analysis** – Visualizing crime density across regions.
- **Class distribution** – Detecting imbalances in crime types for appropriate handling during modeling.

5. Feature Engineering

To improve predictive accuracy, new features are derived from raw data:

- **Temporal features** – Hour of the day, day of the week, month, holiday indicators, and lag variables representing past crime counts over different time windows.
- **Spatial features** – Grid or beat identifiers, proximity to hotspots, density of POIs (bars, ATMs, schools), and infrastructure metrics like road density and lighting.
- **External features** – Weather conditions and event indicators.

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Target variables are defined for both classification (crime occurrence or type) and regression (crime count). To address class imbalance, methods like **class weighting** or **SMOTE** are applied.

6. Model Development

Two types of approaches are used:

- **Supervised Learning** for classification and regression:
  - Baseline models such as **Logistic Regression** and **Linear Regression**.
  - Advanced models like **SVM** with RBF kernel and **K-NN**, which require feature scaling.
  - Ensemble techniques like **Random Forest** or **XGBoost** for improved performance.
- **Unsupervised Learning** for hotspot detection:
  - **K-Means clustering** on spatial and temporal density features.
  - Alternative methods like grid-based thresholding for simplicity.

4. IMPLEMENTATION

When we talk about using technology to fight and prevent crime, we need to remember one thing: it's not just about advanced software or cutting-edge tools—it's about people. The officers on the streets, the analysts working behind the scenes, the support teams, and the communities they serve are at the heart of this effort.

➢ Ease of Use Comes First

If the system is complicated or doesn't fit naturally into daily workflows, it won't make much difference. The technology must be simple and intuitive. No one should need to be a tech expert to operate it. Whether it's a touchscreen in a patrol car or an office dashboard, accessing information should take just a few clicks. The goal is to support people, not slow them down.

➢ Flexibility is Essential

Every department operates differently, and every community faces unique challenges. That's why the system should be easy to customize. It should feel like it was designed specifically for your team—not like a generic solution you need to adapt to. Customization ensures that the technology fits your needs, not the other way around.

➢ Security Cannot Be Overlooked

This technology handles highly sensitive data—about officers, community members, and active cases. People need to trust that this information is secure and managed responsibly. Without trust, the system will fail, no matter how advanced it is.

➢ Rollout and Training Matter

Introducing the system is just as important as building it. Training should be clear, simple, and accessible to everyone. Users should feel that their feedback, concerns, and suggestions are valued. The system should evolve as people use it more. Change can be challenging, but when people feel supported and included, adoption becomes much smoother.

➢ People First, Always

At the end of the day, technology is a tool—and its power depends on how well it serves people. When designed with people in mind, it makes officers' jobs easier, builds community trust, and creates smarter, more effective ways to prevent and solve crime.

5. RESULTS AND DISCUSSION

Solving crimes is a complex process that demands both human expertise and intelligence, supported by Artificial Intelligence (AI) techniques to assist in detecting and analyzing criminal activities, as highlighted in [14]. Predicting future crime patterns primarily focuses on identifying changes in crime rates over time and applying predictive methods to anticipate these trends in the coming years.

According to [15], crime prediction using artificial neural networks (ANNs) often achieves higher accuracy and evaluates target functions more efficiently compared to other approaches. This trend was observed in the case of the San Francisco dataset, where neural networks outperformed other algorithms on testing data.

However, as noted in [16], one of the main challenges lies in developing techniques that can effectively handle the ever-growing volume of crime data. The accuracy of crime prediction largely depends on the quality and size of the dataset used for training. A large dataset generally allows the model to achieve high accuracy, while a smaller dataset results in limited training and reduced accuracy. Additionally, the dimensionality of the training data also influences

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prediction performance. A well-trained model yields more accurate results, whereas an inadequately trained model produces poor outcomes.

6. SNAPSHOTS

Fig 1: Home Screen

Fig 2: Data set Selection Page

Fig 3: Crime History Dataset

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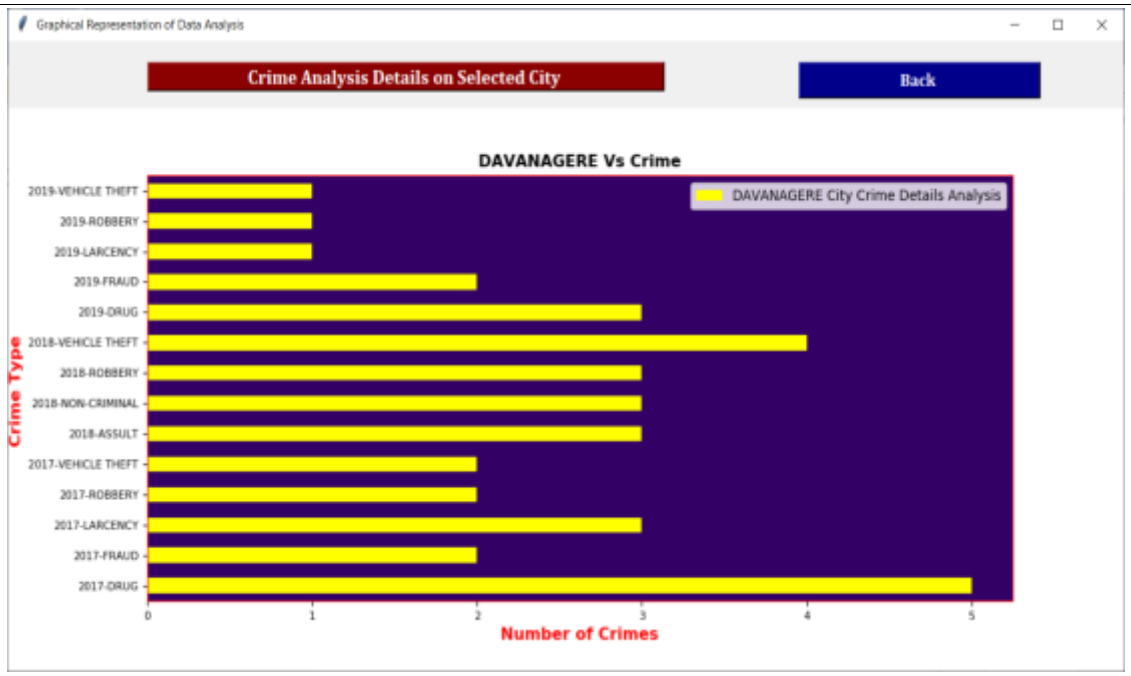

Fig 4: Graphical Representation of Analyzed Data

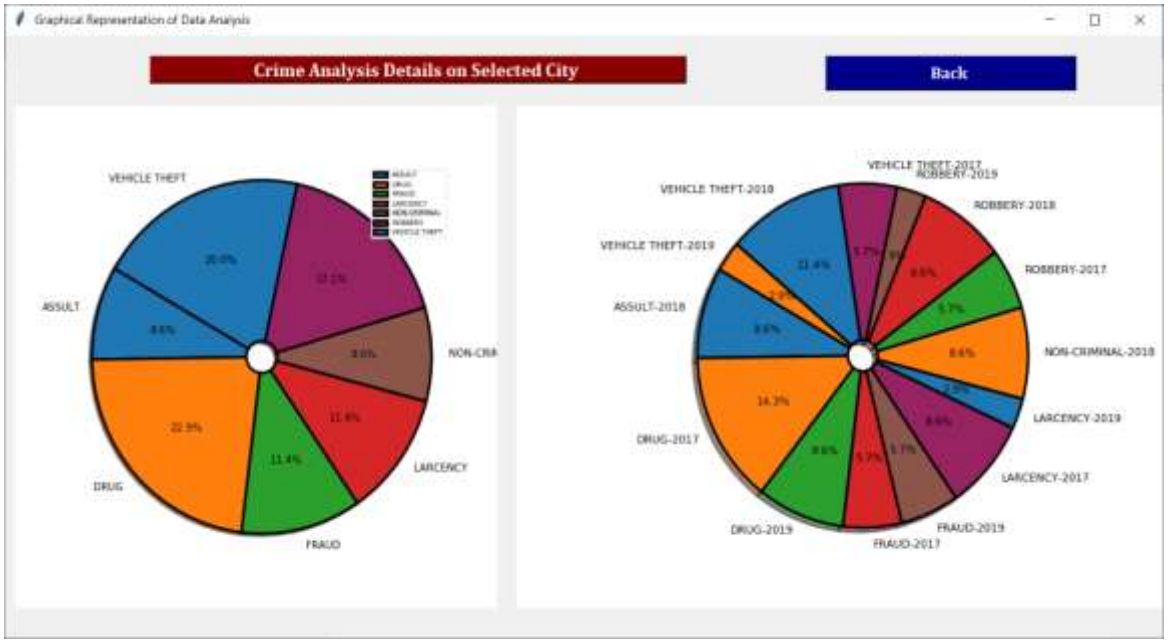

Fig 5: Graphical Representation of City Data

7. CONCLUSION

In this project, we developed a machine learning-based system that analyzes historical crime data and predicts future crime patterns in urban areas. Through advanced data processing and predictive algorithms, the model offers valuable insights that assist law enforcement agencies in making informed, strategic decisions.

What sets this system apart is its ability to go beyond analyzing past records—it forecasts crime rates by considering factors such as location, time, and crime type. This empowers police departments and city administrators to identify high-risk areas, allocate resources efficiently, and implement preventive measures before incidents occur.

Moreover, this predictive approach contributes to long-term planning. By recognizing trends and patterns, authorities can design effective community programs, strengthen safety measures, and address the root causes of crime.

By merging criminology with modern data analytics, this system serves as a powerful tool for smarter policing. As technology evolves, solutions like these will play a crucial role in reducing crime rates and creating safer, more secure communities for everyone.

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