

Crime Prevention Technologies in Law Enforcement

Matthew N. O. Sadiku¹, Paul A. Adekunle², Janet O. Sadiku³

¹Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA

²International Institute of Professional Security, Lagos, Nigeria

³Juliana King University, Houston, TX, USA

ABSTRACT

The field of law enforcement has been undergoing a remarkable transformation with the integration of many new technologies. Technology is revolutionizing crime prevention by providing law enforcement agencies with innovative tools and strategies. Law enforcement officials can benefit from advanced technology as they uncover criminal activity and deliver justice. They are increasingly employing technologies for crime prevention, including surveillance systems, biometrics, GPS tracking systems, automated license plate readers, and predictive policing tools. These technologies aim to enhance situational awareness, improve response times, and ultimately deter criminal activity. With the help of the technologies, law enforcement can now analyze data, predict crime patterns, and respond quickly to emerging threats. In this paper, we explore the role of technology in modern crime prevention and identify the key technologies driving this revolution.

KEYWORDS: *crime, crime prevention, crime prevention technologies, law enforcement, policing.*

INTRODUCTION

Technology has become an indispensable tool in modern society, affecting every aspect of our lives, including our justice system. Advanced technology has transformed the law enforcement field, bringing both new possibilities and challenges. Technology is increasingly vital for corrections, rehabilitation, and within the juvenile justice system. It can improve accuracy in investigations and policing. It has become a crucial tool in crime prevention, revolutionizing law enforcement, surveillance, and public safety. Equipped with a comprehensive array of technological solutions, law enforcement officials and departments are able to accomplish more with less.

Technology has become a revolutionary and integral component of the modern criminal justice system. It is transforming every aspect of our lives, including the way we prevent crime and promote justice. With the advent of technology, law enforcement agencies are now leveraging innovative tools and strategies to enhance crime prevention. Traditional methods have relied heavily on community policing, patrols, and investigations [1]. While traditional methods of law

enforcement and community vigilance remain crucial, the integration of technology into crime prevention strategies has revolutionized safety and crime detection. Law enforcement agencies are beginning to use crime prevention approaches to keep their communities safe.

A crime is an unlawful act punishable by a state or other authority. The most popular view is that something is a crime if declared as such by the relevant and applicable law. One proposed definition is that a crime or offence (or criminal offence) is an act harmful not only to some individual but also to a community, society, or the state ("a public wrong"). Such acts are forbidden and punishable by law [2]. A criminal activity is displayed in Figure 1 [3]. Crime prevention encompasses a wide range of strategies that address the three elements of the crime triangle, shown in Figure 2 [4]. As crime evolves with modern advancements, technology provides innovative solutions to detect, prevent, and solve criminal activities effectively. In today's policing environment, it is smart to focus on crime prevention

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as a foundational strategy. The focus of community crime prevention is on strengthening communities through the provision of services that build connections between community members and connect them to external resources and services that can help them combat crime.

WHAT IS CRIME PREVENTION?

Crime prevention is the ability to understand and respond to drivers and inhibitors of crime, including crowd management, public trust, mental health and wellbeing. It has been a cornerstone of law enforcement strategies for decades. Crime Prevention is the anticipation, recognition, and appraisal of a crime risk, and the initiation of action to remove or reduce it, as illustrated in Figure 3 [4]. The crime prevention triangle is illustrated in Figure 4 [4]. It shows that a crime can be prevented if the offender's desire, ability, or opportunity is removed. If any one of the three sides of the triangle is missing, the offender cannot/will not commit the crime.

Crime prevention strategies have evolved over the years. Prevention of crime is more closely related to proactive policing than reactive policing. There has been a longstanding argument that prevention of crime has greater value for the public than reacting to crime. Traditional crime prevention methods have focused on visible policing, such as patrols and stop-and-search operations. While these methods have been effective to some extent, they have limitations. Technology is transforming crime prevention by providing law enforcement agencies with proactive tools and strategies. Part of crime prevention is ensuring that personnel are always where they are most needed.

The best way to fight crime is to keep it from happening in the first place, and technology is on the forefront of crime prevention. Law enforcement agencies are harnessing new technology to enhance crime prevention, detection, and apprehension. Two types of technological innovations have benefited the criminal justice system: hard technology and soft technology. Hard technology includes innovations in materials, devices, and equipment that either prevent crime or are used to commit crime. Soft technology includes software programs, classification systems, crime analysis techniques, and data sharing/system integration techniques. The fusion of hard and soft technologies has not only fortified preventative measures but has also empowered agencies to better understand, anticipate, and respond to emerging threats [5].

CRIME PREVENTION TECHNOLOGIES

Law enforcement agencies face an immense challenge when it comes to conducting investigations

and formulating crime prevention strategies — they need the right tools. As shown in Figure 5, the police need technology that keeps them ahead of crime [6]. Crime prevention technologies encompass a range of tools and systems used to deter, detect, and respond to criminal activity. These days, crime prevention technologies incorporate the most cutting-edge concepts and opportunities. These technologies include surveillance systems, predictive policing software, biometric identification, drones, automatic license plate readers (ALPR), body-worn cameras, and communication systems, all aimed at enhancing public safety and security. Some of these technologies have been covered in earlier papers and will not be treated here. Common crime prevention technologies include the following [4,7,8]:

1. *Surveillance Systems*: One of the most significant contributions of technology to crime prevention is the advancement of surveillance system. As a critical component of policing, surveillance involves close observation with the intention of gathering evidence to support investigations. High-definition cameras in public spaces provide real-time monitoring and can be used to identify suspects and deter crime. AI can analyze video feeds from surveillance cameras to detect suspicious behavior or anomalies, triggering alerts for law enforcement. These cameras, including those in public spaces and on police vehicles (body-worn cameras), act as a deterrent and provide valuable evidence. Closed-Circuit Television (CCTV) cameras, drones, and AI-powered facial recognition software help law enforcement agencies monitor public spaces and identify potential threats in real time. Figure 6 shows some surveillance cameras [9]. Such public surveillance cameras not only collect valuable evidence, their presence alone can have a chilling effect on crime. The cameras serve as a visible reminder to potential offenders that they are being watched and recorded. AI-powered surveillance systems use machine learning algorithms to analyze footage from CCTV cameras. These systems can detect suspicious behavior, identify potential threats, and alert law enforcement in real-time. Drones equipped with cameras offer a versatile surveillance tool, particularly in areas with limited access or during large events. GPS technology is used to track the location of individuals or vehicles, aiding in investigations and preventing crimes.
2. *Predictive Policing*: This involves using algorithms and statistical models to identify potential crime hotspots and high-risk individuals.

Predictive policing uses data analytics and machine learning algorithms to identify high-crime areas and predict when and where crimes are likely to occur. It falls into two broad categories—predictions of places and predictions of persons. AI-powered systems analyze crime data to predict potential hotspots and allocate resources effectively, allowing for proactive crime prevention. Drawing on advanced algorithms capable of forecasting criminal activity, predictive policing uses historical crime details and other vast data sets to reveal when individuals are more likely to commit crimes. This can also provide insight into where and how to deploy law enforcement officials. For example, Santa Cruz police envisioned deploying officers by shift to the most targeted locations in the city. Their predictive policing model helped to alert officers to targeted locations in real time, a significant improvement over traditional tactics. The algorithm is a culmination of anthropological and criminological behavior research. It uses complex mathematics to estimate crime and predict future hot spots. Additional departments in the states of California, Washington, South Carolina, Arizona, Tennessee, and Illinois have implemented the program. Each department that implemented the predictive policing software achieved crime reduction. One major criticism lies in the limited scope of crimes that prediction software can predict. Concerns have also been raised over the accuracy of crime data that are used for predictive policing.

3. *Biometrics*: Police have been using fingerprints to identify people for more than a century. Biometric technology, including fingerprint scanning, retina recognition, and DNA profiling, plays a vital role in identifying criminals and verifying identities. Biometrics provides measurements of physiological characteristics. As an advanced form of biometrics, facial recognition software uses AI to match faces to images compiled within a vast database. Facial recognition and other biometric technologies are used to identify individuals and track their movements. Fingerprint and DNA databases are used to identify suspects and victims, providing crucial evidence in investigations. Facial recognition technology can be used to identify individuals in surveillance footage and match them against databases of known offenders or missing persons, aiding in investigations and arrests. Figure 7 shows the use of fingerprints in law enforcement [1]. Beyond fingerprints, other biometric characteristics like facial recognition, voice

recognition, and gait analysis are being used to enhance identification methods.

4. *Gunshot Detection Systems*: These systems detect the sound of gunfire and pinpoint its location, enabling rapid response. The systems can quickly identify the location of gunshots, enabling faster response times for law enforcement. This new and still-improving technology uses sensitive audio sensors placed around a neighborhood to detect gunshots and show officers the exact location. Gunshot detection technology relies on acoustic sensors to notify dispatchers in the event of firearm discharges. This law enforcement technology helps officers respond faster to gunshot incidents, which gives them a leg-up on assisting victims and tracking down suspects. GDS technology has the potential to make communities much safer, especially in areas where there are not enough officers to be on patrol 24/7. These are primarily used in areas known to experience high levels of firearm crime. Gun violence, human trafficking, and other serious felony crimes are often concentrated at specific geographic places, and long-time efforts to prevent these crimes have not been consistently successful. New gunshot detection systems are being implemented in some US cities to show police officers exactly where and when a gunshot was fired.
5. *Cell Phone Technology*: Smartphones are increasingly utilized by law enforcement agencies as versatile tools for crime prevention and investigation, enhancing communication, information access, and community engagement. They facilitate faster communication, information sharing, and access to crucial data, ultimately contributing to safer communities. The smartphone can be a powerful part of the modern police officer's toolbox, even when solutions such as radio dispatchers are available. The value of the simple cell phone lies primarily in its versatility; it remains the technological jack-of-all-trades. Unique advantages afforded by cell phones include searching alleged offenders' cell phones for texts and other records.

APPLICATION OF CRIME PREVENTION TECHNOLOGIES

Crime can be prevented through a combination of tools or activities that include increasing the risk (CCTV), increasing the effort needed to complete a crime, reducing the rewards (convenience stores with limited cash in a till), removing the opportunity and eliminating excuses for deviant behavior. Crime prevention technologies are extensively used in

border security, forensic investigations, and access control systems, making it harder for criminals to evade law enforcement. Common applications of the technologies include the following [10-13]:

- *Crime Prevention Training:* The complexities of modern policing have required law enforcement agencies to expand how officers are trained to do their jobs. It is not sufficient for training to focus solely on the law or on perishable skills. In recent years, there has been little crime prevention-specific training offered at the basic academy level. Crime prevention training for new officers varies from zero to eight hours. To produce officers who can successfully perform community-oriented policing techniques, police academies and agencies must train recruits and patrol officers in crime prevention techniques to be independent, creative problem solvers.
- *Crime Prevention Cybersecurity:* As technology advances, cybercrime has become a significant threat. Governments and businesses use cybersecurity measures, including encryption, firewalls, and AI-driven threat detection, to protect sensitive data and prevent financial fraud, hacking, and identity theft.
- *Public Safety:* Mobile applications and smart technologies empower citizens to contribute to crime prevention. Apps like emergency alert systems, crime reporting platforms, and GPS tracking devices enhance personal safety and enable quick reporting of suspicious activities. Smart home security systems with IoT-enabled devices provide additional protection against burglaries.
- *Forecasting Future Crimes:* Crimes do not occur randomly or uniformly in time or space or society. Crimes do not occur randomly or uniformly across neighborhoods, or social groups. There are hot spots and cold spots; there are high repeat offenders and high repeat victims. Crimes can be predicted. The use of big data and IoT technologies are making investigations easier for police and justice systems. They provide a surveillance system that spots crimes and ensures perpetrators are brought to justice. At the same time, it enables investigators to analyze crime trends as well, which helps police to forecast when and where violent crimes will occur, and ensure that they have the resources in place to prevent them. For example, the Hyderabad City Police in India employs data analytics to detect crime hotspots and forecast future activity by combining past crime records, weather trends, and socioeconomic indicators. Data and social

scientists from the University of Chicago, utilizing publicly available data on violent and property crimes, have developed an algorithm to forecast future crimes. By learning from the time and geographical locations revealed by this data, the algorithm can “predict” future crimes one week before they happen, with up to 90% accuracy.

- *Remote Monitoring:* It is now possible to monitor camera footage remotely, 24 hours a day, 365 days a year. AI technologies can detect and report suspicious activity that it has learned through the absorption of images of similar crimes. AI such as HunchLab can create a picture of crime patterns and trends and predict how likely a particular crime is to occur at various locations across a specific time period. These new AI technologies allow law enforcement to prevent crimes before they even happen.

BENEFITS

The integration of technology into crime prevention strategies has many benefits. It has revolutionized safety and crime detection. Law enforcement agencies are beginning to use crime prevention approaches to keep their communities safe. In today’s cost-restricted policing world, police commanders are taking innovative and cost-effective approaches to preventing crime in their communities. Other significant benefits include [14]:

- *Trust:* Crime prevention through community trust building, partnerships, enforcement, and environmental and situational awareness and education is the most cost-effective way of achieving success. Prevention is proactive; it is targeted; it addresses quality of life; and it is adaptable.
- *Officer Protection:* Technology is being used in ways to more effectively protect officers. One of the more exciting developments taking shape is the development of a sophisticated “smart belt.” Worn by officers on duty, the belt monitors the officer’s movements and position, and it automatically alerts backup or dispatch of trouble when necessary. Other tools being implemented to improve officer safety include drones, robotic cameras, and small robots that can be used in dangerous situations. For example, these robots can be used to surveil a hazardous scene or locate threats.
- *Crime Prevention and Detection:* Technology enables law enforcement to analyze data and identify patterns, allowing them to prevent crimes before they occur. AI and data analytics can

analyze crime patterns, identifying potential hotspots and predicting future criminal activity. This allows law enforcement to proactively deploy resources and prevent crimes before they occur. Smart surveillance networks, including cameras and drones, can provide real-time monitoring, detect threats, and aid in investigations.

- *Evidence Collection:* Advanced tools and techniques for analyzing digital evidence (e.g., cell phones, computers) can help solve crimes more quickly and efficiently. Cloud-based storage allows for secure and accessible storage of large amounts of digital evidence, making it easier to manage and share with investigators. Video redaction services can protect the privacy of individuals in video footage, allowing for the use of evidence while safeguarding sensitive information.
- *Increased Efficiency:* Technology automates many tasks, freeing up resources for more strategic and proactive policing. Automated dispatch systems optimize emergency response times, ensuring that resources are deployed effectively. Analyzing data can help identify trends, optimize staffing, and improve resource allocation across different areas of law enforcement.
- *Communication:* Real-time communication tools facilitate communication between different units, departments, and jurisdictions. Law enforcement agencies can use social media to communicate with the public, gather information, and build trust.
- *Predictive Analytics:* Analyzing data can reveal crime patterns, allowing for proactive policing strategies. By analyzing data, law enforcement can identify emerging crime trends and adapt their strategies accordingly. Data analytics and predictive policing provide law enforcement with data-driven insights, enabling them to make informed decisions.

CHALLENGES

The criminal justice system faces numerous challenges, but technology promises to provide a major edge in everything from detection to apprehension. If there is a downside to the crime prevention technologies mentioned above, it is their complex ethical concerns. Used irresponsibly, these systems risk infringing on basic rights. Other challenges include the following:

- *Ethical Concerns:* While crime prevention technologies offer significant benefits for crime

prevention, they also raise ethical concerns. The use of AI and predictive policing raises questions about bias, privacy, and the potential for over-policing of color communities. It is crucial to ensure that these technologies are implemented responsibly and ethically, with proper safeguards to protect individual rights and freedoms.

- *Privacy Concerns:* The use of surveillance technologies raises privacy concerns, requiring careful consideration of ethical and legal implications. Closely tied to transparency is the need to address the ethical and legal issues surrounding predictive policing. Predictive policing software developers and law enforcement agents should take cognizance of civil and privacy rights.
- *Bias:* AI and ML algorithms can perpetuate existing biases if they are trained on biased data. This can lead to discriminatory policing practices. Algorithms used in predictive policing and facial recognition can be susceptible to bias, potentially leading to unfair targeting of certain groups. If the predictions are informed by inaccurate and biased data, this will eventually result in biased and unlawful policing practices.
- *High Cost:* Implementing and maintaining crime prevention technologies can be expensive, requiring significant investment from law enforcement agencies. An obstacle lies in the high cost of predictive policing software (such as PredPol and Azevea) since some of the companies develop the software for commercial purposes.
- *Training:* As the criminal justice field grows more reliant on high-tech solutions, professionals at all levels will be expected to be proficient with cutting-edge tools and techniques. This calls for targeted training, including extensive practice with many types of devices, software, and systems. Rapid improvements are expected, plus better training to ensure that criminal justice professionals are prepared to handle their challenges effectively and ethically. It is crucial that any training involving technological solutions must also delve into their ethical and legal manifestations. Criminal justice professionals must thoroughly understand how to use advanced technology without infringing on civil rights.
- *Transparency:* Concerns have been raised over public transparency and social and legal ramifications of predictive policing technologies. Transparency denotes openness and susceptibility of systems to review by an independent person or

body. Due to the highly technical nature of predictive policing, public transparency should be a priority. There is a danger that the predictions become the results of a process hidden in a black box, making it difficult for citizens and policy makers to comprehend. There is need for measures to enhance transparency in developing and implementing predictive policing.

CRIME PREVENTION AROUND THE WORLD

Law enforcement agencies worldwide face the problem of doing more with less. Police department handles the same issues with increasing property crimes and service calls and diminishing staff. Crime prevention is the epitome of good police work and is the overarching goal of law enforcement agencies around the world. As cities worldwide face growing populations and evolving criminal threats, law enforcement agencies turn to cutting-edge technologies to enhance public safety and prevent crime. Here we document the use of crime prevention technologies in the following countries [15-18]:

- *United States:* In many parts of the United States, crime prevention is primarily addressed by local law enforcement agencies with a focus on the specific types of crime that are most significant in their localities. The United States of America is perhaps the first nation to utilize software applications for predictive policing. In 2011, researchers from three universities, in collaboration with analysts from Santa Cruz Police Department, developed a predictive policing software. For example, PredPol examined gun-related crimes in Chicago between 2009 and 2011 and analyzed them in comparison with homicides, wherein a positive correlation was established between gun-related crimes and homicide. Los Angeles developed a project called Operation LASER (Los Angeles Strategic Extraction and Restoration), which identifies individuals who are likely to commit crime.
- *Europe:* Predictive policing has also been embraced in some European jurisdictions. In Germany, applied predictive policing mainly focusses on residential burglary. The Netherlands were the first country in the world to deploy predictive policing on a national scale. Several police forces in the Netherlands are turning to the Crime Anticipation System (CAS) for predictive policing.
- *United Kingdom:* At the inception of predictive policing in the UK, police forces mainly relied on commercially developed software programs whose usage was, however, discontinued due to high costs. For example, the London Metropolitan Police developed the Gang Matrix, which identifies potential members of crime gangs and allocates scores on gang members based on the perceived risk that they pose to communities.
- *Canada:* Crime prevention projects and initiatives in Canada that are garnering excellent results concentrate on improving the overall health and wellness of communities. The National Crime Prevention Strategy provides a policy framework for the implementation of crime prevention interventions in Canada. The primary role of this national-level program is to aid the implementation and sustainability of effective crime prevention programs; provide research; and, in some cases, facilitate grant funding. The program's goal is to prevent and reduce substance abuse and related crime and interpersonal violence. One Canadian initiative is the Clearwater River Dene Nation (CRDN) Project Venture which was launched on July 25, 2017. CRDN strives to achieve these goals through in-school and after-school curricula, recreational and skill-building activities, community service learning, peer leadership, counseling, and support
- *India:* Crime prevention is a critical issue in India. Technology plays an important part in crime prevention in India with developments such as CCTV, face recognition, predictive policing, digital communication tools, and forensic improvements. The fast growth of technology provides significant instruments for increasing public safety and lowering crime rates. Surveillance technology such as CCTV and face recognition systems are becoming more common in cities throughout India to improve public safety and avoid criminal activity. Predictive policing, based on modern data analysis, allows Indian law enforcement to be more proactive, which results in safer neighborhoods and more efficient police techniques. For example, Hyderabad City Police effectively used predictive policing.
- *UAE:* The UAE, particularly Dubai, is in charge of smart policing with several innovative solutions. For example, Dubai Police introduced a self-driving patrol car and "Amna," a virtual police officer capable of handling Arabic and English inquiries, showcasing AI's integration into public services. In addition, the world's first unmanned self-service Smart Police Stations (SPS) have been developed, allowing citizens to access various police services without human interaction. In Abu Dhabi, police share video clips from city surveillance cameras to raise public awareness of traffic violations. This

proactive approach helps manage road safety more effectively, reducing accidents and improving traffic flow. By moving from reactive to proactive crime prevention, cities in the Middle East and globally can create safer, more efficient environments.

CONCLUSION

In simple terms, crime prevention is the attempt to reduce and/or deter crime. Technology is transforming police work in the 21st century, introducing new tools to fight crime and new categories of crime to fight. It continues to play a pivotal role in crime prevention by improving surveillance, enhancing cybersecurity, and aiding law enforcement agencies with advanced tools. While criminals also exploit technology for unlawful activities, constant advancements in AI, biometrics, and predictive analytics provide a robust defense against crime. Crime prevention may be characterized as acts and inventions aimed at reducing crime, the likelihood of crime, and the negative consequences of crime. Crime prevention technologies are constantly evolving, offering new tools and strategies for law enforcement and communities to work together to create safer environments.

Crime prevention is no easy task for law enforcement, which is why they need the help of various technologies to do it. The incorporation of technology in crime prevention has fundamentally transformed how law enforcement combats criminal activities. Surveillance systems, predictive policing, social media forensics, and biometrics are arming law enforcement with the tools they need to continue fighting crime in a digital era. Technological advances will continue to enhance law enforcement's ability to protect public spaces and, by extension, will continue to aid efforts to prevent crime and apprehend criminals. More information about crime prevention technologies can be found in the books in [19-24].

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Figure 1 A criminal activity [3].

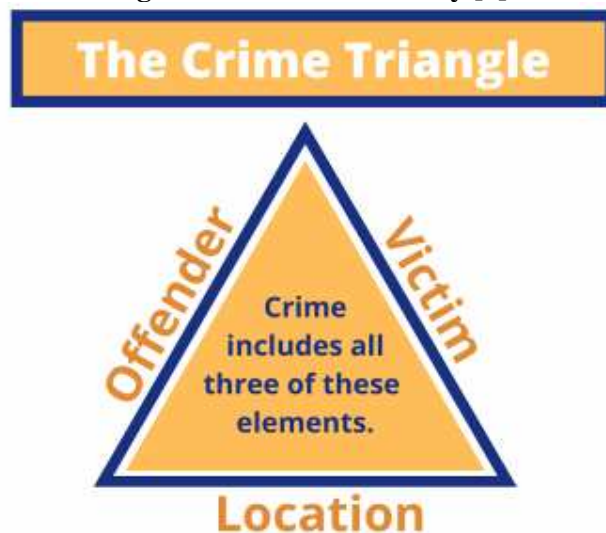


Figure 2 The crime triangle [4].



Figure 3 Definition of crime prevention [4].



Figure 4 The Crime Prevention Triangle [4].



Figure 5 The police need technology that keeps them ahead of crime [6].



Figure 6 Surveillance cameras [9].



Figure 7 Use of fingerprints in law enforcement [1].