Enhancing Criminal Detection: A Multi-Step Approach for Live Location Tracking and Emotion Verification Using Facial Recognition Technology

Yahya Abdulsattar Mohammed

Computer Engineering Department, University of Mosul, Mosul- Iraq
E-mail: yahya.enp80@student.uomosul.edu.iq

Abstract - **This paper offers a thorough analysis of the state of deceit detection in criminal justice and law enforcement settings as of right now. The study, which synthesizes findings from multiple investigations, emphasizes the progress made as well as the ongoing difficulties in accurately distinguishing deception from truth. The limitations of conventional techniques like behavior analysis interviews and polygraph exams, the potential of alternative strategies like voice tone analysis and facial expression analysis, and the moral ramifications of using emotional AI systems for deception detection are some of the main subjects covered. The review highlights the necessity for ongoing interdisciplinary research efforts and ethical concerns through critical analysis and discussion, in order to progress the field of deception detection while maintaining justice and respect to human rights values.**

Keywords: Deception detection, Law enforcement, Criminal justice, Behavioral analysis, Polygraph examinations, Facial expressions, Vocal tones, Emotional AI, Ethics.

I. INTRODUCTION

Many security protocols have been created over time to protect sensitive information and reduce the possibility of security breaches. Face recognition is one of these biometric techniques that stands out for its great accuracy and low intrusion [1]. This technique extracts face traits from digital photos or video frames and uses computer programmers to automatically identify and validate people. It can be used as hardware for authentication or it compares these attributes with a database of recognized faces. Face recognition systems are widely used in procedures related to identity, authorization, verification, and authentication [2].

Numerous businesses include facial recognition technology into their access controls and security camera systems. Facebook utilizes facial recognition technology, for example, to generate virtual profiles for its users. Furthermore, to help identify suspects, law enforcement authorities in affluent nations keep facial databases up to date. Malaysia, on the other hand, mostly uses fingerprint identification for

criminal investigations [3]. However, because fingerprint detection techniques are now widely used, criminals are aware of them and often take efforts, such wearing gloves, to avoid leaving recognizable prints, especially in non-premeditated crimes. In contrast to conventional thumbprint matching methods, this article suggests implementing a facial recognition system for criminal databases, providing a more dependable and effective means of identifying suspects [4].

This paper suggests creating and deploying a facial recognition system for criminal databases in this study. In contrast to conventional thumbprint matching methods, which are rapidly being exploited by astute criminals, facial recognition provides a more reliable and cutting edge method of identifying suspects. Through the use of an individual's distinct facial traits, including their arrangement and proportions, the suggested approach seeks to improve the efficacy and precision of criminal investigations. Furthermore, the use of facial recognition technology is in line with international trends in security and biometric authentication.

We anticipate notable gains in the efficiency and speed of suspect identification through the incorporation of face recognition technology into current law enforcement protocols, which will eventually support increased public safety and crime prevention initiatives.

II. USE OF FACE EMOTION DETECTION AND RECOGNITION

A multi-step procedure is proposed to identify the live location of a criminal's face and confirm their emotion. First, face recognition technology is employed, with the assistance of CCTV cameras. Face detection, in which the camera recognizes and defines a face; face analysis, in which the features of the face are measured and examined; and face recognition, in which the identified face is compared to an identity stored in a database, are the three primary processes involved in this process.

Subsequently, the current criminal image is contrasted with an earlier one. In order to do this, first create a white

background, then copy and paste the old image, insert the new live image, and then compare the faces. The next step is the use of Convolutional Neural Networks (CNNs) for photo classification [5].

Selecting a dataset, getting it ready for training, producing training data with labels applied, defining and training the CNN model, and lastly validating its correctness are all part of this process. A face ratio software that analyses facial proportions and offers an emotional analysis is used to detect emotions on a live face [6].

In order to do this, the image must be inserted, examined, scored, and the facial ratio output must be shown. By identifying the criminal's IP address, it is possible to track their current whereabouts. For more information, law enforcement can contact Internet service providers (ISPs) and utilize websites equipped with tracking devices to obtain IP addresses [6].

The result of this procedure helps police and cybercrime departments assess the issue by giving real-time information on the criminal's emotional state in public areas. All things considered, these techniques provide useful instruments for detecting and tracking illegal activities, strengthening security protocols, and promoting public safety [7]. Figure (1) shows the steps of Sequential Steps for Live Location Detection and Emotion Verification of Criminal Faces

The process begins with face detection using computer vision techniques, followed by facial recognition to match detected faces against a database of criminals. Emotion recognition algorithms analyze facial expressions for signs of distress or aggression. Concurrently, location tracking technologies pinpoint the live location of individuals.

These components integrate to assess threat levels in real-time, generating alerts if a match to a criminal face, coupled with concerning emotions and suspicious location, is detected. Continuous monitoring ensures the system adapts to evolving threats, enhancing overall effectiveness in live location detection and emotion verification of criminal faces.
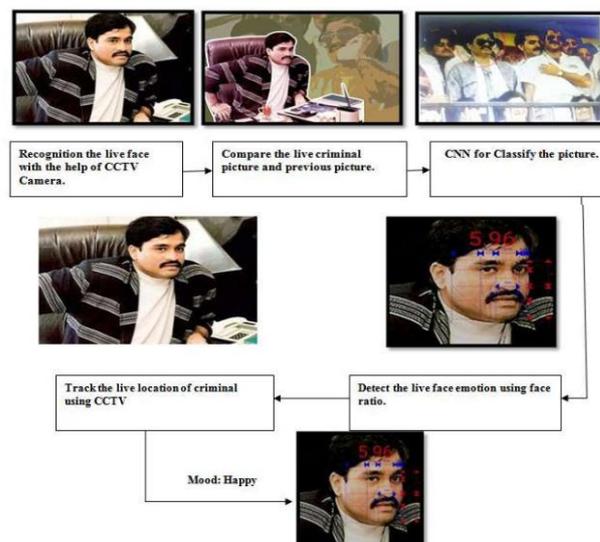

Figure 1: Sequential Steps for Live Location Detection and Emotion Verification of Criminal Faces

III. RELATED WORKS

A thorough summary of studies and research initiatives in the topic of deception detection and related fields can be found in the Table (1). A sophisticated subset of behavior analysis tools, deception detection is frequently applied in criminal justice and law enforcement practices. To distinguish honesty from dishonesty, researchers have looked into a number of techniques, such as behavior analysis interviews, polygraph tests, and the possible use of emotional AI technology.

We look at the work of a number of researchers who have tackled important issues and investigated novel directions in deception detection in this table. The table provides an overview of the present status of research in this area by outlining the issue statements, objectives, methodology, results, strengths, and limitations of each study.

Readers will be able to comprehend the intricacies of deception detection and the continuous efforts to improve its accuracy and dependability with this thorough explanation. The table also emphasizes how this field of study is interdisciplinary, spanning the domains of psychology, technology, law enforcement, and ethics.

Table 1: Related Works Analysis

Researcher	Problem	Objectives	Method	Results	Strength Points	Limitations
Datta (2020) [8]	Privacy concerns regarding the use of biometric data for identification.	To examine the privacy implications of using biometric data for	Literature review and analysis of privacy concerns.	Identified privacy concerns including loss of anonymity, risk of losing control over sensitive	Provides insight into the privacy implications of biometric data usage.	Limited scope, may not cover all potential privacy concerns.

				information, potential misuse for tracking.		
Lombroso (2006) [9]	Attempting to identify "criminal traits" through body measurements.	To investigate the possibility of identifying physical characteristics associated with criminality.	Observational studies and measurements of individuals' physical traits.	Failed to establish a deterministic connection between physiology and criminal behavior.	Historical significance in the development of criminological theories.	Ridden with logical and methodological fallacies, lacks reliable evidence.
Siegel (2012) [10]	Critiquing the validity of biometric-based explanations for criminal behavior.	To evaluate the reliability and validity of biometric-based theories of criminal traits.	Critical analysis of existing biometric-based theories and evidence.	Found lack of reliable evidence supporting deterministic link between physiology and criminal behavior.	Highlights flaws in biometric-based theories of criminality.	Some studies may be outdated, and critiques may vary in depth and rigor.
Campisi (2013) [11]	Privacy concerns associated with biometric data usage, including potential misuse.	To explore the privacy risks and implications of using biometric data.	Review of literature on privacy issues related to biometric data.	Identified risks such as loss of anonymity and potential for misuse in tracking individuals.	Raises awareness about privacy risks associated with biometric data.	May not cover all potential privacy risks, limited by available literature.
Fussey et al. (2021) [12]	Questioning the accuracy of facial recognition technology used by police forces in the UK.	To assess the accuracy of facial recognition technology utilized by police forces.	Empirical study evaluating the accuracy of facial recognition technology in identifying individuals from CCTV footage.	Found concerns regarding the accuracy of facial recognition technology, raising doubts about its reliability for identifying individuals.	Provides empirical evidence on the accuracy of facial recognition technology in real-world scenarios.	Limited to the context of the UK and may not generalize to other regions or jurisdictions.
Jones (2021) [13]	Examining the use of police body-worn cameras and the potential implications for surveillance and human rights.	To investigate the impact of police body-worn cameras on surveillance practices and human rights.	Mixed methods research involving surveys, interviews, and analysis of police practices and policies regarding body-worn cameras.	Identified implications of body-worn cameras for surveillance practices and human rights, including concerns about privacy and civil liberties.	Offers insights into the multifaceted effects of police body-worn cameras on surveillance and human rights.	Findings may vary based on specific police practices and policies, and generalizability could be limited to certain contexts.
McStay (2019) [14]	Proposing the concept of "emotiveillance" and discussing the potential	To introduce the concept of emotiveillance and explore its potential effects	Conceptual analysis and discussion of the implications of emotional AI	Suggested that embedding emotional AI in surveillance systems could	Offers a theoretical framework for understanding the potential societal	Lack of empirical evidence to support claims, primarily theoretical and

	implications of embedding emotional AI technologies in surveillance systems.	on privacy and human rights.	technologies for surveillance and privacy.	amplify privacy concerns and infringe on human rights.	impacts of emotional AI in surveillance contexts.	speculative in nature.
Meijer and Wessels (2019) [15]	Defining predictive policing as the collection and analysis of data about previous crimes.	To provide a definition and conceptual framework for predictive policing.	Literature review and conceptual analysis of predictive policing methods.	Defined predictive policing as the collection and analysis of data about previous crimes, with objectives including identifying high-risk places and times, individuals at risk of being offenders or victims, and potential suspects.	Provides a clear definition and framework for understanding predictive policing.	May lack empirical evidence and practical implementation considerations.
RAND (2013) [16]	Discussing the application of machine learning in predictive policing to identify high-risk places, times, and individuals.	To explore the use of machine learning in predictive policing for crime prevention and law enforcement.	Literature review and analysis of predictive policing methods and technologies.	Explored the potential of machine learning in predictive policing for identifying high-risk places, times, and individuals, with implications for crime prevention and law enforcement strategies.	Offers insights into the potential applications and benefits of machine learning in predictive policing.	May lack in-depth analysis of ethical and legal implications.
Babuta et al. (2019) [17]	Addressing legal and ethical questions raised by the use of machine learning in predictive policing, including concerns about system bias.	To examine the legal and ethical implications of using machine learning in predictive policing.	Legal and ethical analysis of predictive policing practices and technologies.	Identified concerns about system bias, legal and ethical implications, and potential discriminatory effects associated with the use of machine learning in predictive policing.	Raises awareness about the legal and ethical challenges associated with the use of machine learning in predictive policing.	May focus more on legal and ethical analysis rather than technical aspects.
Fussey et al. (2019) [18]	Critiquing live facial recognition technology for racial bias, discrimination, and its impact on privacy and civil	To assess the impact of live facial recognition technology on privacy, civil liberties, and potential biases	Empirical study evaluating the accuracy and implications of live facial recognition	Found concerns about racial bias, discrimination, and negative impacts on privacy, freedom of expression, and freedom of	Provides empirical evidence on the potential risks and negative impacts of live facial recognition	Limited to the context of live facial recognition technology, may not cover broader issues in predictive

	liberties.	and discrimination.	technology.	assembly associated with live facial recognition technology.	technology.	policing.
Richardson et al. (2019) [19]	Highlighting biases and discriminatory effects in predictive policing tools, including disproportionate policing of certain communities.	To identify biases and discriminatory effects in predictive policing tools and practices.	Analysis of predictive policing algorithms, practices, and outcomes.	Demonstrated biases and discriminatory effects in predictive policing, including disproportionate policing of historically over-policed communities and issues regarding accountability for decisions.	Raises awareness about the biases and discriminatory effects inherent in predictive policing practices.	May not provide comprehensive solutions to address biases and discriminatory effects.
Meijer et al. (2019) [20]	Complexities surrounding crime prediction and its aim in crime prevention.	To explore the complexities and goals of crime prediction in the context of crime prevention.	Literature review and conceptual analysis of crime prediction and prevention strategies.	Identified the complexities of crime prediction with the aim of crime prevention, including the challenge of accurately predicting crime based on various factors.	Provides insights into the multifaceted nature of crime prediction and its implications for crime prevention strategies.	May lack empirical evidence and practical implementation considerations.
Kaufmann et al. (2019) [21]	Utilizing crime prediction to identify targets for police intervention and assess risk of re-offending for individuals.	To assess the effectiveness of crime prediction in identifying intervention targets and assessing risk of re-offending.	Analysis of crime prediction methods, risk assessment tools, and their application in law enforcement practices.	Highlighted the potential of crime prediction in identifying intervention targets and assessing risk of re-offending, contributing to decision-making in law enforcement.	Offers practical implications for law enforcement agencies in utilizing crime prediction tools for intervention and risk assessment.	May overlook ethical and legal considerations associated with crime prediction and intervention.
Li et al. (2021) [22]	Investigating the correlation between emotional states and criminal intent, and the classification of emotions for crime prediction.	To examine the possibility of connecting emotional states to criminal intent and classify emotions for crime prediction.	Review of existing literature on emotional AI technologies, empirical studies on emotional classification, and their application in	Found limited empirical evidence on the correlation between emotional states and criminal intent, highlighting the need for further research on emotional classification and its applicability in	Addresses the need for more empirical research on emotional AI technologies and their potential for crime prediction.	Lack of empirical evidence to support claims, primarily theoretical and speculative in nature.

				crime prediction.	crime prediction.		
Ferrandino (2013) [23]	Evaluating the effectiveness of human-based behavior detection methods, such as stranger-to-stranger behavior detection and police stop-and-search actions, in crime prevention.	To assess the effectiveness of human-based behavior detection methods in preventing crime.	Analysis of reports and studies on human-based behavior detection methods and their outcomes in crime prevention efforts.	Identified limitations and concerns regarding the effectiveness of human-based behavior detection methods in preventing crime, including low success rates in detecting criminal activity and potential biases.	Raises awareness about the limitations and challenges of human-based behavior detection methods in crime prevention.	May not cover the potential effectiveness of machine learning-based behavior detection methods.
Lee et al. (2018) [24]	Identifying suspicious behavior at cashpoint/ATM machines to prevent crimes.	To develop a system for identifying suspicious behavior at cashpoint/ATM machines for crime prevention.	Development of a machine learning-based system to analyze behavior at cashpoint/ATM machines and identify suspicious patterns.	Proposed a machine learning-based system capable of identifying suspicious behavior at cashpoint/ATM machines, potentially aiding in crime prevention efforts.	Offers a practical application of machine learning technology for crime prevention in a specific context.	May lack real-world testing and validation of the proposed system.
Martínez-Mascorro et al. (2020) [25]	Detecting shoplifting behavior using machine learning technology.	To develop a machine learning system for detecting shoplifting behavior in retail settings.	Development and testing of a machine learning-based system for analyzing video footage and identifying shoplifting behavior.	Proposed a machine learning-based system capable of detecting shoplifting behavior in retail settings, potentially aiding in loss prevention efforts.	Provides a practical application of machine learning technology for preventing retail crime.	May be limited by the accuracy and reliability of the machine learning algorithms in real-world scenarios.
Singh (2018) [26]	Developing a real-time drone surveillance system for detecting violent individuals in public spaces.	To design and implement a real-time drone surveillance system for identifying and monitoring violent behavior in public spaces.	Development of a real-time drone surveillance system equipped with computer vision algorithms to analyze aerial images and identify individuals exhibiting violent behavior.	Proposed a real-time drone surveillance system capable of identifying violent individuals in public spaces, potentially aiding in law enforcement efforts to prevent violence.	Offers a novel approach to using technology for public safety and crime prevention.	May face challenges related to privacy concerns and public acceptance of drone surveillance.

Wright (2021) [27]	Investigating the VibraImage emotion recognition technology for detecting human emotions.	To evaluate the effectiveness and transparency of the VibraImage emotion recognition technology in detecting human emotions.	Literature review and analysis of available information on the VibraImage technology and its operation.	Identified concerns regarding the lack of transparency and disclosure of details about the VibraImage technology, raising questions about its effectiveness and reliability in detecting human emotions.	Raises awareness about potential issues with the transparency and reliability of emotion recognition technology.	Limited by the lack of available information and transparency regarding the VibraImage technology.
Sánchez and Dencik (2020) [28]	Developing intelligent surveillance systems for analyzing crowd behavior and detecting anomalies or unusual behavior.	To create intelligent surveillance systems capable of analyzing crowd behavior and detecting anomalies or unusual behavior for public safety and security.	Development and testing of intelligent surveillance systems equipped with computer vision algorithms for analyzing crowd behavior and detecting anomalies or unusual behavior.	Proposed intelligent surveillance systems capable of analyzing crowd behavior and detecting anomalies or unusual behavior, potentially aiding in public safety and security efforts.	Provides insights into the development and application of intelligent surveillance systems for crowd analysis.	May be limited by the accuracy and reliability of the computer vision algorithms in identifying anomalies or unusual behavior. May also face challenges related to privacy concerns and public acceptance of surveillance.
Bond Jr. et al. (2006) [29]	Inaccuracy in lie-truth discrimination accuracy among lie experts and non-experts.	To evaluate the lie-truth discrimination accuracy among lie experts and non-experts.	Analysis of lie-truth discrimination accuracy based on expert and non-expert evaluations.	Concluded that lie experts and non-experts achieve less than 55% lie-truth discrimination accuracy on average.	Provides empirical evidence on the limitations of lie-truth discrimination accuracy among lie experts and non-experts.	Limited to analysis of existing literature, may not capture real-world application scenarios.
Strömwall et al. (2004) [30]	Inaccurate beliefs about nonverbal cues of deception among practitioners.	To examine inaccurate beliefs about nonverbal cues of deception among practitioners.	Literature review and analysis of practitioner beliefs and biases in deception detection.	Concluded that practitioners, including lie experts, hold inaccurate beliefs about nonverbal cues of deception, influenced by police interrogation manuals and culture.	Highlights the influence of police culture and interrogation manuals on practitioner beliefs about deception detection.	Limited to analysis of existing literature, may not capture real-world application scenarios.
Vrij et al. (2007)	Lack of knowledge about cues of deception	To theorize the possibility that low accuracy rates	Theoretical analysis and literature review	Proposed that low accuracy rates in deception detection	Raises awareness about the potential impact	Theoretical analysis may not fully capture the

[31]	among participants, both expert and non-expert.	in deception detection studies are partially due to participants' lack of knowledge about cues of deception.	of deception detection studies and participant knowledge.	studies may be due to participants' lack of knowledge about cues of deception.	of participant knowledge on deception detection accuracy.	complexity of deception detection in real-world scenarios.
Synnott et al. (2015) [32]	Limited reliability and accuracy of standard polygraph measurements in deception detection.	To evaluate the reliability and accuracy of standard polygraph measurements in deception detection.	Literature review and analysis of studies on standard polygraph measurements and their effectiveness in deception detection.	Concluded that existing research on polygraph technology does not provide reliable evidence for extremely high accuracy in deception detection.	Provides insights into the limitations of standard polygraph measurements in deception detection.	Limited to analysis of existing literature, may not capture real-world application scenarios.
Shen et al. (2021) [33]	Limited evidence for the correlation between facial expressions/vocal tones and deception.	To investigate the correlation between facial expressions/vocal tones and deception.	Literature review and analysis of studies on facial expressions, vocal tones, and their potential correlation with deception.	Identified limited evidence for the correlation between certain micro-facial expressions and deception, highlighting the need for more research in this area.	Highlights the need for further research on the correlation between facial expressions/vocal tones and deception.	Limited to analysis of existing literature, may not capture real-world application scenarios.

IV. DISCUSSION

The studies included in the table provide insightful information on the intricate topic of deception detection, revealing both ongoing improvements and persistent obstacles. Researchers have struggled with the inherent challenges of distinguishing truth from deceit using a variety of methodologies and approaches, especially in the context of law enforcement and criminal justice. A significant discovery is the restricted precision of conventional methods like behavior analysis interviews and polygraph tests, as evidenced by research conducted by Frank Horvath, Bond Jr. et al., and Strömwall et al. These results highlight the need for more comprehensive instruction and training to reduce biases and increase practitioners' capacity to recognize deceit. Additionally, studies on alternate methods—like examining vocal tones and facial expressions—show potential but also emphasize how difficult it is to link these signs to dishonest behavior. Sánchez-Monedero and Dencik's critical analyses of emotional AI systems, however, highlight significant ethical and societal issues and highlight the necessity of deception detection technologies being deployed and governed responsibly. Future developments in deception detection will depend heavily on cooperation between academics, professionals, and legislators in order to uphold moral norms and human rights legislation. Through the resolution of these issues and the responsible application of new technology, deception detection can develop further and support equitable and efficient procedures in criminal justice systems across the globe.

V. CONCLUSIONS

The research compiled in the table highlights the intricacy and continuous development of deception detection methods in the domains of criminal justice and law enforcement. Determining truth from deceit is difficult, even with great attempts to increase accuracy and dependability. The accuracy of traditional approaches, including behavior analysis interviews and polygraph exams, is limited, which emphasizes the necessity for practitioners to have more training and education. Furthermore, studies into alternate strategies, such as the examination of vocal tones and facial expressions, show promise but still need verification and

improvement. In order to protect people's rights and privacy, ethical concerns around the use of emotive AI systems for deception detection also call for close examination and regulation. The topic of deceit detection will need to advance through multidisciplinary cooperation and ongoing study in order to maintain ethical norms and human rights principles. Accurate and equitable deception detection techniques can help ensure just and efficient results in criminal justice systems across the globe by tackling these issues and sensibly utilizing developing technologies.

ACKNOWLEDGEMENT

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