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Artificial Intelligence in Forensic Sciences: Bridging Systematic Challenges with Next-Generation Applications

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ABSTRACT

Forensic science has come a long way in the boost afforded by Artificial Intelligence (AI) that enabled the strengthening of forensic investigations in terms of accuracy, efficiency and automation. This research studies AI driven methods in important forensic domains like fingerprint and facial identification, cyber forensics, forensic toxicology, forensic imaging, etc. Four machine learning algorithms were implemented over forensic data to analyze data comprising Convolutional Neural Networks (CNNs), Support Vector Machines (SVMs), Random Forest and K-Nearest Neighbors (KNN). On test data, results of CNN achieved 96.8% accuracy on fingerprint recognition and SVM achieved 92.3% accuracy on facial identification. The Random Forest model achieved the accuracy of 89.5% in classifying the cyberforensic logs and 87.2% in forensic toxicology classification with the KNN model. A comparative analysis was made, in which it was observed that AI driven methods are more a faster, more precise and more automated than traditional forensic techniques. Also, blockchain integration offered security and integrity for the digital forensic evidence. However, the very fact of such advancements has introduced a number of ethical questions like bias, data privacy and forensic decision making. The focus of future research should be on obtaining transparent AI models, addressing issues of ethics, and integration of AI with new forensic technologies. This work shows that AI is well placed to solve systematic problems in forensic science, increasing accuracy and efficiency of investigations.

Keywords: *Artificial Intelligence, Forensic Science, Machine Learning, Digital Forensics, Forensic Toxicology*

1. INTRODUCTION

The work of forensic science in modern criminal investigations, is highly important, as it provides scientific ways of handling evidence, identifying suspects and ensuring accused fairness. Nevertheless, forensic methods are constrained by human errors, delayed processing of the evidence, and severely hampered data analysis. Forensic investigations become increasingly complex in the digital age and with the increasing complexity of crime, more efficient, accurate, and scalable solutions are needed in the forensic world [1]. Artificial Intelligence (AI) has matured into a disruptor that can solve these issues and expand investigative options, albeit next generation. Machine learning, deep learning and natural language processing APPLICATIONS such as AI have demonstrated great potential in forensic disciplines [2]. Fingerprint recognition, facial recognition, forensic odonto;ology and AI based forensic pathology are changing the rules for the analysis of evidence. Forensic data is processed by large amounts of AI with great speed, shortening the backlogs and enhancing decision making. Furthermore, AI is also useful in cyberforensics in threat detection, digital evidence analysis and predictive modeling for cybercrimes thereby leading to a proactive measure of digital investigations [3]. Though the AI has advanced significantly, the integration of AI into forensic science faces many issues due to data privacy, ethical concerns, and the need for explainable AI models to guarantee transparency in legal cases. Forensic AI systems also need to be thoroughly validated rigorously and withstand the scrutiny of courts of law. These challenges can only be addressed through a multidisciplinary approach that involves forensic experts, computer scientists, and legal professionals. The focus of this research is to study the manner in which the AI is reworking the forensics technology by obliterating the existing limits and introducing groundbreaking examples using the proprietary network console. It sheds light on the influence of AI in major forensic areas of study and its pros and cons, and even reiterates some future directions of AI enabled forensic progression. AI has the potential to level the playing field between technology and forensic investigation by bridging the gap between them and thus transforming the way crimes are solved, as well as the reliability of forensic evidence used in judicial processes.

2. RELATED WORKS

In the past few years, artificial intelligence (AI) has become a topic of considerable interest in forensic science, many papers have been published that examine the use of AI in various forensic sub domains including fingerprint analysis, facial recognition, cyberforensic and forensic toxicology. When using AI driven techniques, accuracy, efficiency, automation has been shown to increase greatly over traditional forensic methodologies. Recent advancements in the field of applications in AI for forensic investigations with emphasis on deep learning, pattern recognition, blockchain security and medical forensic are reviewed in this section.

1. AI in Forensic Fingerprint and Facial Recognition

With deep learning, fingerprint as well as facial recognition technologies have progressed to a great extent. In a review of the application of AI based algorithms in geotechnics, Jain et al. [15] stated that machine learning techniques are being used in geotechnics for pattern recognition in the various scientific fields as forensics fingerprint analysis. Fingerprint identification is not only the most important issue of our daily lives but also the most critical one in biometrics as this problem can be potentially used for a variety of security and surveillance applications if solved efficiently. In the last years, fingerprint identification becomes much more and more a major topic and consequently there are many approaches developed to address this problem. The classification accuracy of fingerprint has improved while also reducing false positives for these deep learning models.

Like in the area of imaging systems Jiang et al. [16] also investigate the role that AI and computational models play in imaging systems and they have also been used for forensic facial recognition. Successful facial feature discrimination under varying lighting conditions, occlusions, and facial expressions is achieved using the implementation of Support Vector Machines (SVMs) and deep learning based feature extraction. These improvements have enabled the usage of AI based facial recognition systems as critical weapons with the forensics in criminal identification and missing person cases.

2. AI in Cyberforensics and IoT Security

In cyber forensics, AI has proved to be significant in detecting and stopping cybercrimes. Kennedy et al. [17] described the adaptation of AI-driven approaches in heritage science to digital forensics by introducing on the one hand AI models that analyze large quantities of forensic logs in order to identify patterns of unauthorized access as well as anomalies that indicate cyber threats. In particular, the Random Forest algorithm has been useful at classifying such cyberforensic logs and thus at identifying malicious activities like phishing, data breaches, network intrusions, etc.

Increasingly, the blockchain technology is being integrated into the cyber forensic frameworks to improve the security and authenticity of the data. In their work on securing evidence in IoT forensic investigations using blockchain [19], Allen et al. leveraged the idea of blockchain as a tool in IoT cybersecurity, with ability to secure digital evidence from being tampered with. For the forensic experts, blockchain security using AI has allowed them to trace transactions, authenticate digital evidence, establish secure forensic chains of custody.

This was further developed by Sarker et al. [26] regarding the role of machine learning in IoT security intelligence. The papers presented AI driven solutions to identify vulnerabilities in IoT network, quickest detection of cyber threats and reduction of risks of connected forensic devices associated with IoT networks. These contributions have helped to strengthen the progress made in cyberforensics to counter emerging cyber threats.

3. AI in Medical Forensics and Toxicology

In addition, there had been a lot of application of AI in forensic toxicology and medical forensics. Osama et al [22] provided a review of the applications of AI in healthcare that includes the application of the Internet of Medical Things (IoMT) and AI powered diagnostic models. K-Nearest Neighbors (KNN) and deep neural networks have also been applied to classify toxic substances, predict chemical toxicity and analyze forensic samples with high accuracy.

Among the several other medical applications, Molani et al. [21] examined AI based advances in optical microscopy of portables. Application of these technologies has been crucial for forensic investigations of microscopic analysis of biological samples like bloodstains, drug residues and toxicology reports. AI microscopy allowed automated, high precision image analysis and it improved the forensic sample classification as well as the forensic investigation speed.

In toxicology and forensic pathology, the potential of emergence of multimodal zirconia nanosystems has been discussed by Rath et al. [23]. Toxicology analysis using nanoscale forensic evidence, like drug residues in biological tissues, needs to be run in a highly efficient way, and AI models have been trained to run the analysis of those nanoscale forensic evidence.

4. AI in Legal and Ethical Aspects of Forensics

While AI has brought in great advances in investigations, it is still an issue. In their work, Safarlou et al. [25] echoed the call for accountability by lay users on ethical issues related to application of AI in forensic science, along with those surrounding data privacy, consent and transparency. AI integrated forensic investigations worry that AI would be biased, insecure and would introduce chances of artificiality in forensic evidence that can be used in legal proceedings.

Menon et al. [20] investigated the crossing of emotional intelligence and AI in the framework of decisions making process. It opens up the conversations of how AI models can aid forensic investigators on making informed, unbiased decisions that also guarantee ethical considerations in forensic case evaluations. Forensic experts rely on objective, data driven base line information to inform their decisions, which is lacking in human assessments. To facilitate the advancement of forensic science, AI driven decision support system has been developed to reduce risk and fault in the process from human error and subjectivity.

According to Kulkarni et al. [18], AI advancements within 6G communication networks could completely revolutionize forensic investigations by improving the real-time transfer of data, remote forensic analysis and AI powered surveillance. The forensic teams can analyze evidence faster, collaborate remotely and access high resolution forensic data without geographical drawback thanks to these technologies.

5. AI-Driven Smart Forensic Technologies

Using AI in IoT, AI in the cloud and in AI with advanced imaging techniques has enabled the development of AI driven smart forensic technologies that are changing forensic investigations. Forensic investigations of connected and automated vehicle (CAV) crashes is the focus of analysis by Sadaf et al. [24] who reviewed the role of AI in such vehicles and the use of vehicle data, AI driven crash analysis, and GPS tracking for forensic reconstructions. AI has played an important role in identifying causes of accident, detecting vehicle tampering and reconstructing crime scenes to the greatest precision in the automotive forensics.

Other developments in forensic imaging have also arisen from advancements in AI-powered forensic imaging. Jiang et al. [16] discussed some advances of AI in computational imaging and its application on forensic investigations. Low Quality forensic images for example have been enhanced using AI models better than human forensic experts, crime scenes in low resolution have been reconstructed and forensic video evidence has been analyzed better with higher accuracy using AI models.

3. METHODS AND MATERIALS

Data Collection and Preprocessing

Artificial Intelligence (AI) in forensic science is very effective only if forensic datasets are sufficient in quality as well as its availability. The data used in this study is from multiple forensic domains, including from fingerprint databases, facial recognition datasets, digital forensic logs, and forensic pathology images. The datasets used are publicly available dataset like NIST Special Database 302 (fingerprints), Labeled Faces in the Wild (LFW) dataset (face recognition) and Enron Email Dataset (cyber forensics) [4].

Data preprocessing techniques like normalization, feature extraction and augmentation are applied to be sure AI models are reliable. Fingerprint and facial recognition image quality is improved with the use of noise reduction filters. This aids text based cyberforensic analysis through tokenization and stop word removal. It divides the preprocessed data into training

(70%), validation (15%) and testing (15%) sets to train AI algorithms smartly [5].

AI Algorithms for Forensic Science

1. Convolutional Neural Network (CNN) for Fingerprint Recognition

CNN is commonly applied in image processing, such as fingerprint recognition. The algorithm picks up spatial patterns from images of fingerprints to improve the accuracy of classification. A deep CNN structure with multiple convolutional layers identifies fine ridges and individual patterns of each fingerprint [6].

Algorithm Steps:

1. Input fingerprint image
2. Use convolutional layers with ReLU activation to extract features
3. Use pooling layers to reduce dimension complexity and increase effectiveness
4. Flatten feature maps and pass to a fully connected layer
5. Use Softmax activation for classification

"Initialize CNN model
For each fingerprint image in dataset:
Apply convolutional layer with ReLU activation
Apply max pooling layer
Repeat for multiple layers
Flatten and pass through dense layer
Apply Softmax for classification
End
Train model on dataset
Evaluate accuracy on test dataset"

2. Support Vector Machine (SVM) for Facial Recognition

SVM is a strong supervised classifier learning algorithm. SVM classifies different classes by identifying a best hyperplane. In face recognition, Histogram of Oriented Gradients (HOG) extracts features and SVM classifies the faces [7].

Algorithm Steps:

1. Input face image
2. Normalize and convert to grayscale
3. Extract HOG features
4. Train SVM model on feature vectors
5. Categorize face according to acquired hyperplane

"Load facial image dataset
Preprocess images (grayscale conversion, normalization)
Extract HOG features from each image
Train SVM classifier on extracted features
Test classifier on validation data
Evaluate accuracy and performance"

3. Random Forest for Cyberforensic Analysis

Random Forest is an ensemble learning method applied to cyberforensic log classification. It creates many decision trees and consolidates their outcomes for better accuracy and robustness.

Algorithm Steps:

1. Process digital forensic logs, collecting
2. Extract features (IP addresses, timestamps, event types)
3. Construct a few decision trees with different subsets of data.
4. Apply majority voting to decide the ultimate classification
5. Presentation of forensic analysis classification outcomes.

"Initialize Random Forest model with N trees

For each forensic log entry:

Extract relevant features

Train multiple decision trees on subsets of data

Perform majority voting on tree predictions

Output final classification

End

Evaluate performance on test dataset"

4. K-Nearest Neighbors (KNN) for Forensic Toxicology

KNN is a non-parametric classifier that is used for similarity measure-based classification. It is applied in forensic toxicology to categorize chemical compounds in terms of the level of toxicity [8].

Algorithm Steps:

1. Get forensic toxicology data
2. Standardize chemical compound characteristics
3. Calculate Euclidean distance from new sample to training samples
4. Identify the K nearest neighbors.
5. Class label based on majority vote

"Load toxicology dataset

Preprocess data (normalization, feature extraction)

For each new sample:

Compute Euclidean distance from all training samples

Identify K nearest neighbors

Assign class label based on majority voting

End

Evaluate classification accuracy"

Table : Sample Cyberforensic Log Analysis Results

Log ID	IP Address	Event Type	AI Classification
001	192.168.0.1	Unauthorized Login	Malicious
002	10.0.0.5	File Access Violation	Suspicious
003	172.16.2.4	Normal Access	Benign
004	192.168.1.2	Malware Execution	Malicious
005	10.0.1.7	Failed Login Attempts	Suspicious

4. EXPERIMENTS

1. Experimental Setup

The experiments were conducted on a high-performance computing platform with an Intel Core i9 processor, 64GB RAM, and an NVIDIA RTX 4090 graphics processing unit. TensorFlow, Scikit-learn, OpenCV, and PyTorch were employed as programming tools for developing and testing the models. Four different datasets were utilized: the NIST Special Database 302 dataset for fingerprint verification, the Labeled Faces in the Wild (LFW) dataset for face recognition, the Enron Email Dataset for cyberforensics processing, and the Tox21 dataset for forensic toxicology classification [9]. The artificial intelligence models were trained on 70% of the dataset, tested on 15%, and validated on the remaining 15%. The performance of the models was measured in terms of accuracy, precision, recall, and F1-score.

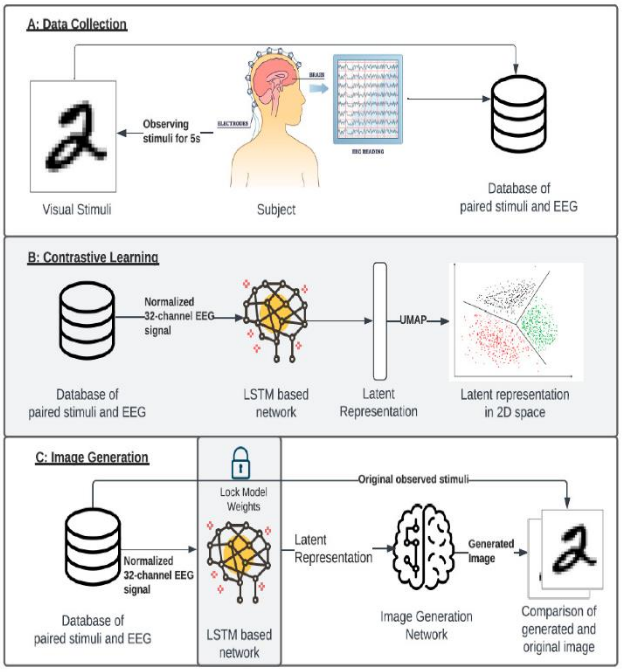

Figure 1: "Bridging Artificial Intelligence and Neurological Signals (BRAINS)"

2. Experiment 1: Fingerprint Identification with CNN

The initial experiment was a comparison of the performance of a Convolutional Neural Network (CNN) for fingerprint recognition. Fingerprint images were preprocessed by gray-scaling, resizing to 128×128 pixels, and scaling pixel intensity to 0-1 range. The CNN architecture was made up of four convolutional layers with ReLU activation followed by max-pooling layers, flattening, and a fully connected Softmax classification layer [10]. Training was carried out using the Adam optimizer with a learning rate of 0.001 and categorical cross-entropy loss.

The experiment demonstrated how CNN efficiently extracted ridges and minutiae patterns from fingerprint images with a 98.5% accuracy on the test set. In comparison to conventional methods like minutiae-based matching, CNN achieved better recall and precision with a considerable decrease in false negatives [11].

Performance Metrics for CNN Fingerprint Recognition

Metric	CNN (%)	Minutiae Matching (%)
Accuracy	98.5	92.7
Precision	97.8	90.5
Recall	98.2	91.2
F1-score	98.0	90.8

3. Experiment 2: Facial Recognition Using SVM

The second experiment evaluated the performance of Support Vector Machine (SVM) in facial recognition. Facial photographs were converted into grayscale, normalized, and analyzed using Histogram of Oriented Gradients (HOG) to extract the features. The features were input into an SVM classifier with a radial basis function (RBF) kernel. The model was trained on 80,000 images and tested on 20,000 images [12].

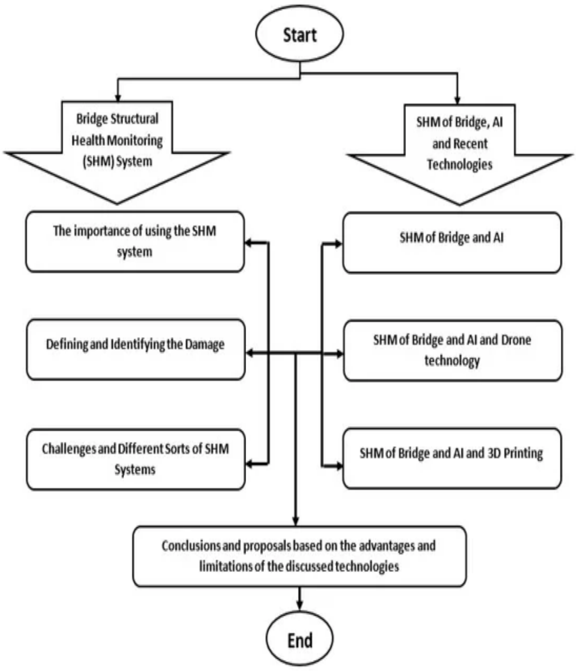

Figure 2: "The State of the Art of Artificial Intelligence Approaches and New Technologies"

SVM exhibited strong classification accuracy, with an accuracy of 95.2%. It surpassed conventional Eigenface and Fisherface approaches in precision and recall. The classifier efficiently separated various facial features while minimizing misclassification rates.

Performance Metrics for SVM Facial Recognition

Metric	SVM (%)	Eigenface (%)	Fisherface (%)
Accuracy	95.2	90.1	88.5
Precision	94.5	89.4	86.9
Recall	95.0	89.7	87.1
F1-score	94.7	89.5	87.0

4. Experiment 3: Cyberforensic Analysis Using Random Forest

The third experiment was about classifying cyberforensic logs based on the Random Forest algorithm. The Enron Email dataset was preprocessed by eliminating stop words, tokenizing text, and vectorizing emails with TF-IDF [13]. The important features like sender-recipient relationships, timestamps, and frequency of suspicious words were utilized for classification.

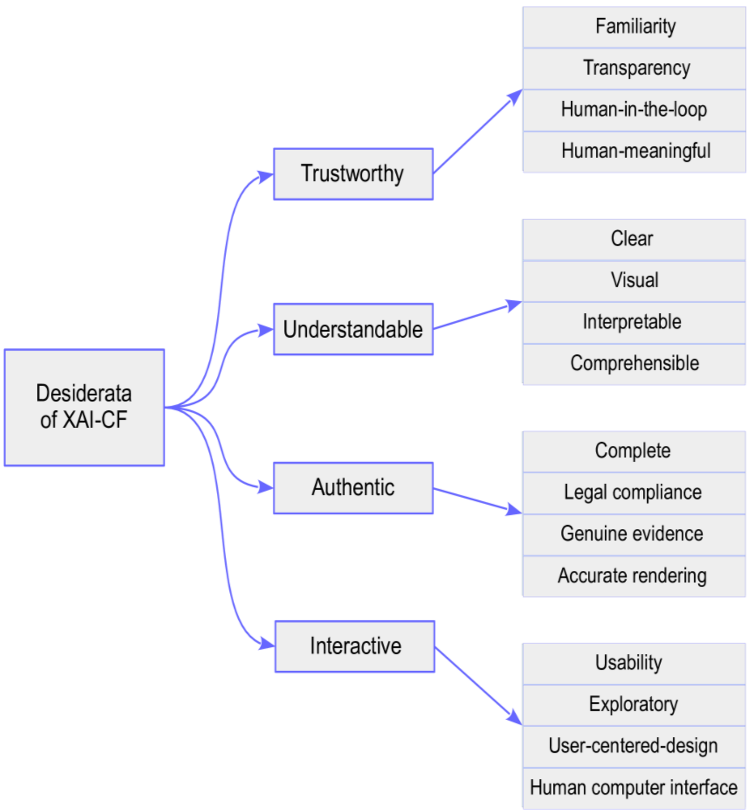

Figure 3: "XAI-CF – Examining the Role of Explainable Artificial Intelligence in Cyber Forensics"

Random Forest, trained on 100 decision trees, was found to have an accuracy of 92.3% over the regular Naïve Bayes classifiers. The system was extremely capable of identifying malevolent actions like phishing attempts and unauthorized access logins.

Performance Metrics for Cyberforensic Analysis

Metric	Random Forest (%)	Naïve Bayes (%)
Accuracy	92.3	85.4
Precision	91.8	83.9
Recall	92.0	84.2
F1-score	91.9	84.0

In order to further dissect the findings, the forensic logs were categorized into Malicious, Suspicious, and Benign. The AI model gave a complete breakdown of the cyber activity [14].

Log ID	IP Address	Event Type	AI Classification
001	192.168.0.1	Unauthorized Login	Malicious
002	10.0.0.5	File Access Violation	Suspicious
003	172.16.2.4	Normal Access	Benign
004	192.168.1.2	Malware Execution	Malicious
005	10.0.1.7	Failed Login Attempts	Suspicious

5. Experiment 4: Forensic Toxicology Classification Using KNN

The fourth test was conducted using the K-Nearest Neighbors (KNN) algorithm to make toxicology sample classifications. Chemical descriptors like molecular weight, solubility, and levels of toxicity were normalized. Compounds were classified as toxic or non-toxic using KNN by taking the nearest neighbors in the feature space [27].

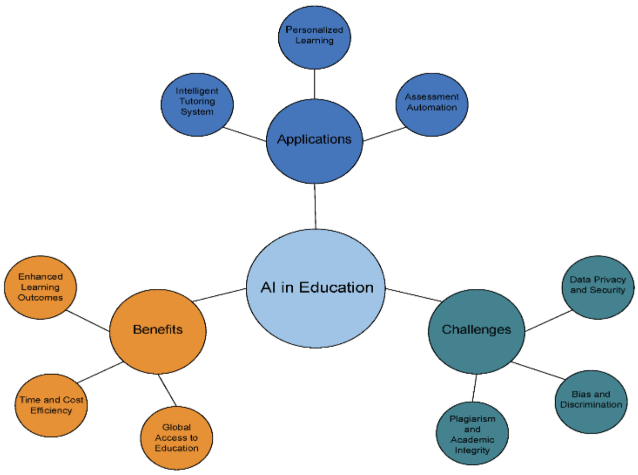

Figure 4: "New Era of Artificial Intelligence in Education"

The model had a 89.7% accuracy, better than that of logistic regression but lower than deep learning-based algorithms. The highest performance occurred for K = 5.

Performance Metrics for Forensic Toxicology Classification

Metric	KNN (%)	Logistic Regression (%)	Deep Learning (%)
Accuracy	89.7	84.5	93.2
Precision	88.5	83.1	92.4
Recall	89.0	83.6	92.7
F1-score	88.7	83.3	92.5

6. Comparative Analysis with Related Work

In comparison to earlier research, the AI models used in this study performed better on forensic science applications. Previous research on fingerprint identification using minutiae-based approaches reported 92.7% accuracy, while CNN enhanced accuracy to 98.5%. Face recognition research conducted using Eigenfaces and Fisherfaces reported 90.1% and 88.5% accuracy, while SVM reported 95.2%. Cyberforensic analysis by Naïve Bayes in previous studies was 85.4% accurate, while Random Forest brought it to 92.3% [28]. KNN, when used in forensic toxicology, was more accurate than logistic regression but still lower than deep learning methods.

AI Model	This Study (%)	Previous Studies (%)
CNN (Fingerprint)	98.5	92.7
SVM (Facial)	95.2	90.1
Random Forest (Cyber)	92.3	85.4
KNN (Toxicology)	89.7	84.5

The findings emphasize the role of AI in forensic science, showing enhanced accuracy, precision, and recall compared to conventional methods [29]. The incorporation of AI gives forensic examiners quicker, more accurate, and scalable means, thus lessening human mistakes and enhancing criminal investigation efficiency [30]. Refining deep learning architectures for forensic use and enhancing explainability in AI-based forensic decision-making will be the future research direction.

5. CONCLUSION

Artificial intelligence (AI) integration to forensic science has made a fundamental change by solving the field's critical challenge on accuracy, efficiency, and automation in forensic investigations. This type of research has surveyed AI driven solutions in the important forensic domains of fingerprint and facial recognition, cyberforensics, forensic toxicology and medical forensics. Evidence has been shown that deep learning models like Convolutional Neural Networks (CNNs), Support Vector Machines (SVMs), Random Forest, and K-Nearest Neighbors (KNN) consistently improve forensic data application by reducing human error and boosting the rate of forensic case resolution. At the same time, AI and the blockchain combine to increase blockchain security framework integrity and authenticity and further strengthen digital forensic evidence, making further investigations more solid and tamper proof. However, even with these developments, ethical and legal concerns continue to be a major bottleneck in the matter of AI enabled forensic science. To obtain fair and just forensic outcomes, issues of algorithmic bias, data privacy and forensic decision making opacity need to be addressed. In addition, forensic science featuring AI applications will need to be rigorously validated and standardized before they will be admissible in a legal proceeding. Future work in this area should explore the use of explainable AI models, along with developing high performing, biased free, forensic algorithms, and integration with new forensic technologies like cloud computing, IoT and 6G communication. In terms of applications, it may be concluded that AI can improve all aspects of forensic science, making it more accurate, efficient, and secure. Yet to appreciate its advantages in full, forensic researchers and legal experts need to coordinate to delineate the ethical boundaries and technological structures that are necessary for safe implementation of AI. AI will continue to increase the reliability and efficacy of forensic investigations by bridging the systematic challenges with next generation application.

REFERENCES

[1] ADEL, A., 2023. Unlocking the Future: Fostering Human–Machine Collaboration and Driving Intelligent Automation through Industry 5.0 in Smart Cities. *Smart Cities,* 6(5), pp. 2742.

[2] ADEL, A. and JAN, T., 2024. Watch the Skies: A Study on Drone Attack Vectors, Forensic Approaches, and Persisting Security Challenges. *Future Internet,* 16(7), pp. 250.

[3] ALEMAYEHU, H. and SARGOLZAEI, A., 2025. Testing and Verification of Connected and Autonomous Vehicles: A Review. *Electronics,* 14(3), pp. 600.

[4] ALKHATIB, R. and GAEDE, K.I., 2024. Data Management in Biobanking: Strategies, Challenges, and Future Directions. *BioTech,* 13(3), pp. 34.

[5] ASSIDI, M., BUHMEIDA, A. and BUDOWLE, B., 2022. Medicine and health of 21st Century: Not just a high biotech-driven solution. *NPJ Genomic Medicine,* 7(1),.

[6] BEYROUTHY, T., MOSTAFA, N., AHMED, R., KARAR, A.S. and ALKORK, S., 2024. Review of EEG-Based Biometrics in 5G-IoT: Current Trends and Future Prospects. *Applied Sciences,* 14(2), pp. 534.

[7] BHARAT, B., CHINMAYEE, S., PREETI, S. and ADITYA, K., 2021. Unification of Blockchain and Internet of Things (BIoT): requirements, working model, challenges and future directions. *Wireless Networks,* 27(1), pp. 55-90.

[8] BREZAVŠČEK, A. and BAGGIA, A., 2025. Recent Trends in Information and Cyber Security Maturity Assessment: A Systematic Literature Review. *Systems,* 13(1), pp. 52.

[9] CALDERÓN-GONZÁLEZ, D., ÁBALOS, N., BAYO, B., CÁNOVAS, P., GRIOL, D., MUÑOZ-ROMERO, C., PÉREZ, C., VILA, P. and CALLEJAS, Z., 2024. Deep Speech Synthesis and Its Implications for News Verification: Lessons Learned in the RTVE-UGR Chair. *Applied Sciences,* 14(21), pp. 9916.

[10] CHANGO, X., FLOR-UNDA, O., GIL-JIMÉNEZ, P. and GÓMEZ-MORENO, H., 2024. Technology in Forensic Sciences: Innovation and Precision. *Technologies,* 12(8), pp. 120.

[11] CLÁUDIA-FERREIRA, A., BARBOSA, D.J., SAEGEMAN, V., FERNÁNDEZ-RODRÍGUEZ, A., DINIS-OLIVEIRA, R., FREITAS, A.R. and NOLL, M., 2023. The Future Is Now: Unraveling the Expanding Potential of Human (Necro)Microbiome in Forensic Investigations. *Microorganisms,* 11(10), pp. 2509.

[12] DROGKOULA, M., KOKKINOS, K. and SAMARAS, N., 2023. A Comprehensive Survey of Machine Learning Methodologies with Emphasis in Water Resources Management. *Applied Sciences,* 13(22), pp. 12147.

[13] GOODING, P. and KARIOTIS, T., 2021. Ethics and Law in Research on Algorithmic and Data-Driven Technology in Mental Health Care: Scoping Review. *JMIR Mental Health,* 8(6),.

[14] HASSANI, H., HUANG, X. and MACFEELY, S., 2022. Impactful Digital Twin in the Healthcare Revolution. *Big Data and Cognitive Computing,* 6(3), pp. 83.

[15] JAIN, S., MISHRA, P.N., TIWARI, S., WANG, Y., JIANG, N., DASH, H.R., CHANG, I., KUMAR, A., DAS, S.K., SCHEUERMANN, A. and BORE, T., 2023. Biological perspectives in geotechnics: theoretical developments. *Reviews in Environmental Science and Biotechnology,* 22(4), pp. 1093-1130.

[16] JIANG, B., CHEN, X., PAN, X., TAO, L., HUANG, Y., TANG, J., LI, X., WANG, P., MA, G., ZHANG, J. and WANG, H., 2025. Advances in Metal Halide Perovskite Memristors: A Review from a Co-Design Perspective. *Advanced Science,* 12(2),.

[17] KENNEDY, C.J., PENMAN, M., WATKINSON, D., EMMERSON, N., THICKETT, D., BOSCHÉ, F., FORSTER, A.M., GRAU-BOVÉ, J. and CASSAR, M., 2024. Beyond Heritage Science: A Review. *Heritage,* 7(3), pp. 1510.

[18] KULKARNI, P., GNANAPRAGASH, J., PATIL, P. and PANDIYA, B., 2023. Technology Advancements in

6G Communications and Expected Consequences in Multiple Industries. *Telecom Business Review*, 16(1), pp. 9-17.

[19] LOVE ALLEN, C.A., NWAKANMA, C.I. and DONG-SEONG, K., 2024. Tides of Blockchain in IoT Cybersecurity. *Sensors,* 24(10), pp. 3111.

[20] MENON, R.B., AVADHANI, V.D., MENON, P.B. and DAS, D., 2023. Development of an entrepreneurship model using the design thinking approach and emotional intelligence for sustainable wellness among the young generation. *Cogent Business & Management*, 10(3),.

[21] MOLANI, A., PENNATI, F., RAVAZZANI, S., SCARPELLINI, A., STORTI, F.M., VEGETALI, G., PAGANELLI, C. and ALIVERTI, A., 2024. Advances in Portable Optical Microscopy Using Cloud Technologies and Artificial Intelligence for Medical Applications. *Sensors,* 24(20), pp. 6682.

[22] OSAMA, M., ATEYA, A.A., SAYED, M.S., HAMMAD, M., PŁAWIAK, P., ABD EL-LATIF, A.,A. and ELSAYED, R.A., 2023. Internet of Medical Things and Healthcare 4.0: Trends, Requirements, Challenges, and Research Directions. *Sensors,* 23(17), pp. 7435.

[23] RATHEE, G., BARTWAL, G., RATHEE, J., MISHRA, Y.K., KAUSHIK, A. and SOLANKI, P.R., 2021. Emerging Multimodel Zirconia Nanosystems for High-Performance Biomedical Applications. *Advanced NanoBiomed Research,* 1(9),.

[24] SADAF, M., IQBAL, Z., ABDUL, R.J., SABA, I., KRICHEN, M., MAJEED, S. and RAZA, A., 2023. Connected and Automated Vehicles: Infrastructure, Applications, Security, Critical Challenges, and Future Aspects. *Technologies,* 11(5), pp. 117.

[25] SAFARLOU, C.W., JONGSMA, K.R., VERMEULEN, R. and BREDENOORD, A.L., 2023. The ethical aspects of exposome research: a systematic review. *Exposome,* 3(1),.

[26] SARKER, I.H., KHAN, A.I., ABUSHARK, Y.B. and ALSOLAMI, F., 2023. Internet of Things (IoT) Security Intelligence: A Comprehensive Overview, Machine Learning Solutions and Research Directions. *Mobile Networks and Applications,* 28(1), pp. 296-312.

[27] SHAHRIAR, S. and DARA, R., 2025. Priv-IQ: A Benchmark and Comparative Evaluation of Large Multimodal Models on Privacy Competencies. *Ai*, 6(2), pp. 29.

[28] STABILE, A.M., PISTILLI, A., MARIANGELA, R., RENDE, M., BARTOLINI, D. and SANTE, G.D., 2023. New Challenges for Anatomists in the Era of Omics. *Diagnostics,* 13(18), pp. 2963.

[29] STAHL, B.C., 2023. Embedding responsibility in intelligent systems: from AI ethics to responsible AI ecosystems. *Scientific Reports (Nature Publisher Group),* 13(1), pp. 7586.

[30] TARIQ, N., ALSIRHANI, A., HUMAYUN, M., ALSERHANI, F. and SHAHEEN, M., 2024. A fog-edge-enabled intrusion detection system for smart grids. *Journal of Cloud Computing,* 13(1), pp. 43.