



AI for Analysis of Complex Crime Scenes

Avasarala C K Sahithi¹, Kola Rajani Priya¹, Gaddam Sasikiran², T Sowmya^{3*}

¹Student, Forensic Science Unit, Department of Chemistry, University College of Science, Osmania University, Hyderabad – 500007, Telangana, INDIA

²Part time Faculty, Forensic Science Unit, Department of Chemistry, University College of Science, Osmania University, Hyderabad – 500007, Telangana, INDIA

³Assistant Professor, Forensic Science Unit, Department of Chemistry, University College of Science, Osmania University, Hyderabad – 500007, Telangana, INDIA

*Corresponding author mail: dr.sowmya@osmania.ac.in

Abstract:

Artificial intelligence (AI) is a discipline under computer science, focusing on producing systems competent enough to accomplish assignments that demand for the human intellect. AI basically, enables computers or devices to work and think like humans. It is being used in day-to-day life and is assisting working professionals in completing challenging tasks. AI is being customized and designed using Python programming. Application of AI has now become a hot spot in developing latest techniques for forensic and crime analysis. Crime Scene analysis generally depends upon experts to collect evidence, identify patterns and draw conclusions which can be supported using AI. In this work, we aim to design an AI prototype that can explore through the given crime scene and identify the potential evidences. The main aim of this AI is to be used in complex crime scenes like arson scenes, explosion scenes and mass disaster scenes, where searching for the evidences becomes challenging in the rubble of the crime scenes. AI can also alert the investigation team regarding the dangerous spots in that crime scene like, any loose electric wires, unexploded or suspicious material if any. It can be integrated with aerial three dimensional scanners by connecting scanner hardware system to AI. AI can analyse the scanned image and hunt through the crime scene to give us better output regarding the available evidences and suspected dangers in the crime scene. This helps to potentially reduce accidents and to identify the main evidences easily in such mess of a crime scene.

Keywords: *Artificial intelligence, complex crime-scenes, AI prototype, aerial 3-D scanners*

1. Introduction:

Artificial Intelligence (AI) is playing a major role in our daily life scenarios. AI at present is finding its applicability in reading the results or interpreting the tests effectively, thus, being a huge help in the field of research. Apart from a research perspective, it is also of great assistance in analyzing huge genomic data, designing novel therapies, analyzing medical images, creating a tailored

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D. R. Reddy et al. (eds.), *Proceedings of the First International Conference on Advances in Forensics and Cyber Technologies (ICFACT 2025)*, Advances in Computer Science Research 127,

https://doi.org/10.2991/978-94-6239-610-4_2

medication for personalized treatment, predicting disease outbreaks, analyzing the FTIR or other instrumental results of forensic samples, and helping in the evidence identification in digital crimes [6]. The evolving AI models are applied in almost all the advancing fields including the technical streams majorly. The main advantage of Artificial Intelligence lies in its accuracy, as it minimizes the chances of human errors.

Despite AI being studied deeply for its applications, there isn't much work on using AI in forensics, mainly for processing and investigating a crime scene. The published work is available on AI being applied in digital forensics to search for the evidence material in the electronic evidences gathered from a computer crime and process those evidences in an automated fashion. Thus, leaving a main gap where, AI is not completely being applied to forensics in real-time.

The present paper aims to design an AI tool efficient enough to be used as a wingman in traditional crime scene investigation of complex crime scenes. In this work presented, a scanner integrated with AI is being designed, such that it can trace out any harmful materials in arson scenes, blast scenes or scenes involving electricity (like unknown packages, electric wires etc.), along with unnoticed skeletal remains etc., in mass disaster scenes (tsunamis, earth- quakes etc.). The findings of this work are capable of contributing to an accident-free investigation, where, the safety of the investigators and the vicinity people is maintained by taking suitable measures to avoid the dangers indicated by the help of this customized AI tool. This might provide an under-structure in developing the applicability of AI to enhance the efficiency and productivity of the traditional forensic approaches.

1.1 Literature Review:

Crime scene investigation is the process of searching for potential evidences, to understand the details regarding the scene of offence like its time of occurrence, reason of occurrence, and who committed the offence [1]. The crime scene is searched for the evidences by the investigation officers using various search patterns like strip method, zone method, spiral method and wheel method [1]. These crime scenes contain debris along with the evidences. This debris at times can be harmful, when approached carelessly. Many people tend to become victims of such accidents most of the times, even when the approaches are precaution oriented, due to unexpected nature of the debris. Few such accidents include the incident that occurred in Malkajgiri, Hyderabad where an electric wire in the debris caused an accident leaving a notable injury on the foot of one of the investigation officers [2, 3]. A similar incident occurred in Nowgam PS, Jammu & Kashmir, where 9 people were killed and about 32 were injured in an accidental blast caused due to the explosion of collected debris from the crime scene in Faridabad [4, 5]. A trial to overcome this problem is to identify such potentially harmful things that are even suspected to be troublesome and a hazard. This can be achieved by using technology that can detect the materials in the crime scene before

anyone can enter into it.

1.1.1 AI in Forensics: The word AI has a range of such significances, from basic AI models to customized variety of AI that are utilized for specific functions [6]. Forensic with computer-based technology was introduced in 1970 [6]. At present, there is a lot more advancement done to it. AI at present is finding a high scope of furnished applicability in digital forensics and cybercrime investigations [7]. Apart from the automation of the evidence handling and selecting efficient tools to examine the identified cyber evidence [7, 10], experiments are in progress about using AI models in crime scene reconstruction, ballistics, forensic psychiatry, forensic pathology, and other branches[8, 14]. Attempts have been conducted to use AI for case-based reasoning for error free and objective based outcomes in many fields of forensic science, neural networks and reproductive results [6, 11]. Many ideas regarding using AI for facial recognition, image analysis, predicting crimes beforehand to prevent them are being brought up as part of AI's evolution in the field of forensics [12].

There is very scanty work focusing on the safety of investigators in dangerous crime scenes, that describe about avoiding the accidents during investigation of scenes like arson and mass disaster cases. Where published materials like, the human risk and work force shortages of investigating hazardous death scenes, have been tried to be investigated using *Agile mobile quadruped robot* [9] and an idea of using AI as a decision support tool in crime scene and forensic image analysis [13], are few. These works lead to the motivation of working on a customized AI model that is efficient enough to scan a complex crime scene for harmful debris to avoid accidents and casualties caused by such accidents, during the investigation of scene and also to identify unnoticed evidential materials in impossibly larger crime scenes like mass disaster scenes.

2. Materials and methods:

The present paper adapts a designing and development type of methodology where the trial for building an AI system is being conducted. The following steps are ought to be adapted in order to successfully design a customized AI:

- i. Problem definition and requirement analysis: The existing AI are tested for the characters they lag, to be suitable for the present study. This helps to understand better about how to build a new AI.
- ii. Data acquisition and preprocessing: In this step, the required data that is necessary to be fed in the code to build the software is collected. This ensures that the targeted objects are being effectively identified by the new AI system to fulfill the objectives of this study.
- iii. Designing the customized AI designed model: Using the collected data, and considering our requirements for the study C++ would be a better option of computer language to code for

this AI. It is because C++ gives better results and is suitable for direct hardware integration and optimization. For this, libraries like PCL for feature extraction and classification, FLIR for sensor integration and Tensor Flow lite for the model deployment can be used.

- iv. Prototype implementation: Once the prototype is ready, it can be tested on few simulated crime scenes to check for its efficiency and accuracy.
- v. Performance evaluation and future development analysis: According to the implementation tests, its performance is estimated and can be taken for the further application or development accordingly.

While the mentioned steps are fully designed and are applicable, yet they are under controlled and phases of execution. This AI system is currently under development. Upon the proper execution of the stated methodology, this AI system is expected to identify the potential hazards in arson scenes, explosion scenes and unnoticed evidences in a mass disaster scene.

3. Results:

The proposed AI system was successfully implemented as a basic functional prototype that exhibited the viability of the adopted designing strategy. It illustrated the feasibility and effectiveness of the appropriate design strategy taken on. The AI is capable enough to process the given inputs and produce the results that align with the objectives of this study. Although thorough qualitative evaluation of the complete prototype and the proper AI system is still a work in progress, the current basic prototype supports the practical application of the planned methodology and confirms that this design supports future enrichment and improvement. This affirms that the basic components of the planned methodology are functional and are capable of a practical application preliminarily.

While a comprehensive qualitative and quantitative evaluation of the complete AI system is still in progress, the current prototype serves as an essential proof of concept. The proposed approach can be transformed into a working system without many limitations. Furthermore, the prototype design model can be scaled up and integrated with advanced algorithms. The proposed prototype can be practically applicable in complex crime scenes and can be enhanced to apply for identification of many such physical evidences in the crime scenes. However, a few limitations might arise not in the functionality of the basic prototype, but due to unavailability of complete data to be fed into the final programme of the actual tool, and there may arise few challenges in integrating the fully developed AI model into a sophisticated thermal or x-ray type scanner.

4. Discussion:

The evaluation of the basic prototype has clearly indicated that this customized AI system performs

better for our objective-specific study when compared to existing general-purpose AI models. This advantage mainly comes from its domain-aware architecture which integrates specific knowledge directly into the system's design, moving beyond generic solutions to create more accurate, reliable, and efficient applications, especially in AI, by tailoring models or services to a particular field. Because it is designed with the concept and limitations of our problem in mind, it can deliver more applicable and substantial outputs compared to baseline models that are built for broad and generic use. Simultaneously, the present study does not include the workflow of the proposed AI model. Further research in this direction is required to test the complete functionality of the model. At the present stage, the reliability of the model can be evaluated and other parameters are required to be tried and tested. While trying to integrate the AI system into external hardware components and supporting infrastructure, there were limitations of available resources, processing capacity of the hardware systems, retention of memory, communication bandwidth, and compatibility issues. All have influences what the current prototype can achieve. To integrate the current AI model which is still under development for real world applications, more enhanced testing has to be performed.

5. Conclusion:

The present paper shows the design and development strategy for building an AI model for application in complex crime scene investigations. The proposed model highlights on the adaptability and feasibility of the basic prototype and evaluated the limitations with the existing models. The current work shows the functionality of the basic prototype. However, evaluation of the AI model and the advanced integration into hardware components are required for testing the performance of the model on real crime scenarios and check its reliability. The study also adds to the AI domain knowledge. The proposed study further helps in development of advanced AI models for the forensic applications. This work helps in gradual evolution of AI in crime scene investigation and other forensic fields contributing to subject specific AI models.

Conflict of Interest: The authors declare no conflict of interest.

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