Crime Detection Tool Using AI and ML

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***Abstract*— This study aims to develop an advanced crime detection simulation tool designed to identify individuals involved in crime situations. By integrating methodologies like handwriting and fingerprint analysis, the tool utilizes machine learning algorithms, including Convolutional Neural Networks (CNNs), for efficient image processing, enabling rapid and accurate identification of potential suspects in real crime scenarios. The tool's noninvasive approach respects personal privacy while empowering law enforcement to swiftly and effectively apprehend suspects. With a focus on proactive crime detection, this tool represents a significant advancement in the field, providing**

law enforcement agencies with a potent and reliable solution to address criminal incidents, thereby enhancing public safety and security.

***Keywords*— Crime detection, fingerprint analysis, machine learning algorithms, image processing**

I. INTRODUCTION

The rise in crime rates nationwide is a cause for concern, with a total of 291,904 IPC (Indian Penal Code) cases reported in 2021. This concerning trend presents substantial obstacles for law enforcement in detecting and resolving criminal activities efficiently. In response to this critical issue, our research endeavors to create a sophisticated crime detection simulation tool that prioritizes the identification of individuals engaged in criminal behavior.

Additional statistics from the National Crime Records Bureau (NCRB) reveal that in 2022, 4,35,477 cognizable crimes were reported in India, albeit with a marginal decrease of 2.2%. Despite this decrease, the absolute number of incidents remains disconcerting. Our project seeks to create a Crime Simulation Detection Tool to tackle these challenges head-on. By harnessing the potential of Artificial Intelligence (AI) and Machine Learning (ML), this tool aims to empower law enforcement personnel in identifying potential suspects, analyzing crime patterns, and deriving valuable insights from complex datasets. This holistic approach to crime detection holds the promise of assisting law enforcement in staying ahead of criminal activities and fostering a safer society. The ultimate goal of our project is to equip law enforcement agencies not only to react to crimes but also to anticipate and prevent them proactively.

Through the application of AI and ML techniques, our tool will enable quicker and more accurate suspect identification, facilitate a deeper understanding of crime dynamics, and provide actionable intelligence for strategic decision-making.

II. LITERATURE SURVEY

In our literature survey, we thoroughly examined over 15 research papers related to crime detection and fingerprint identification. One research paper closely aligned with our study is titled "Fingerprint Image Identification for Crime Detection," published in 2021.[1] The paper presents a comprehensive crime scene fingerprint identification system that employs deep learning, The researchers utilized a Convolutional Neural Network (CNN) for this study. Fingerprint images were collected from crime scenes using precise photography and advanced physical and chemical techniques to ensure high-quality data. These images were archived in a database for future review. However, due to the nature of crime scenes, fingerprint images were often incomplete and challenging to categorize.

III. IMPLEMENTATION OF CONVOLUTIONAL NEURAL NETWORK

Convolutional Neural Networks (CNNs) have shown remarkable success in various image classification tasks. In this particular configuration, a CNN model with three convolutional layers was utilized, achieving an impressive accuracy rate of 99.2% in image classification.

The CNN structure in this setup includes an input layer, three convolutional layers, and a fully connected layer with a subsequent softmax activation function. After every convolutional layer, a max-pooling layer is employed to decrease the spatial dimensions of the features. The output from the third convolutional layer is flattened and passed to a fully connected layer. The final layer utilizes a softmax activation function to generate a probability distribution across the output classes.

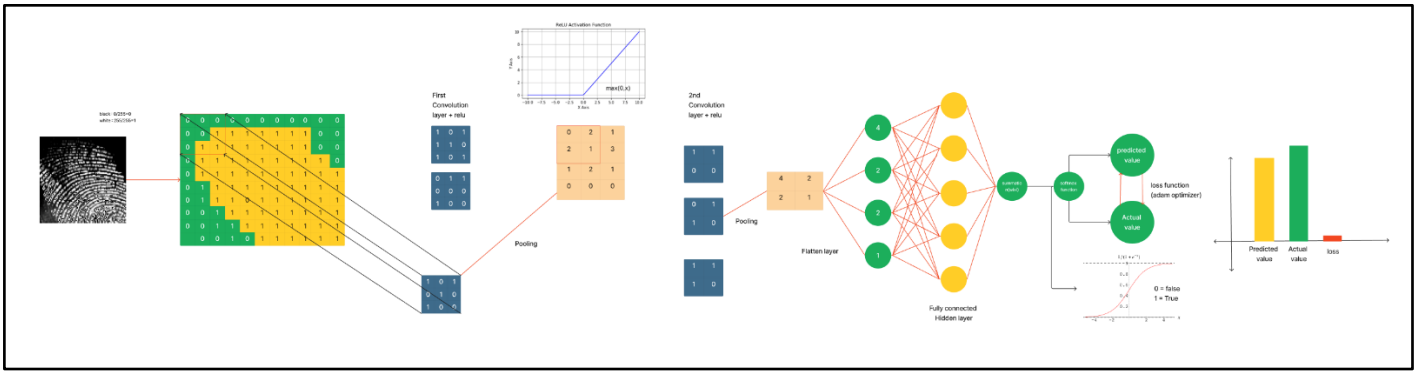


Fig 1. Convolutional neural network

The initial convolutional layer contains 32 filters of size 3x3, along with a rectified linear unit (ReLU) activation function. Following this, the second convolutional layer includes 64 filters also sized 3x3, with a ReLU activation function. Subsequently, the third convolutional layer integrates 128 filters of size 3x3, accompanied by a ReLU activation function. Each convolutional layer starts with some random noise initially, which the model refines through training.

During the training phase, the CNN undergoes training on a large dataset of categorized images, utilizing backpropagation and stochastic gradient descent optimization techniques.

The model is designed to minimize the cross-entropy loss function between the predicted and actual labels. Training continues until the model achieves a satisfactory level of accuracy on a validation set.

To evaluate the model's accuracy, a test set of images is used. The model predicts labels for each image in the test set, and accuracy is calculated based on the percentage of correct predictions. In this particular case, the CNN model demonstrated an accuracy rate of 99.2% on the test set, highlighting its effectiveness in image classification tasks.

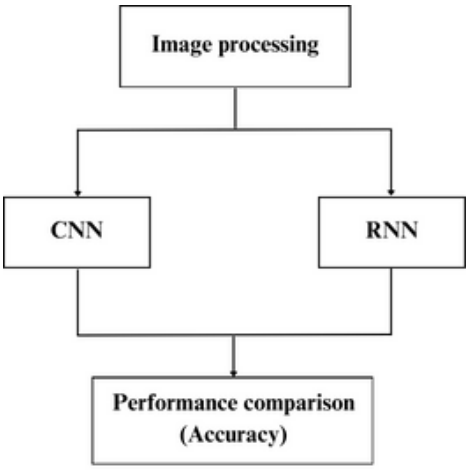


Fig 2. Block Diagram

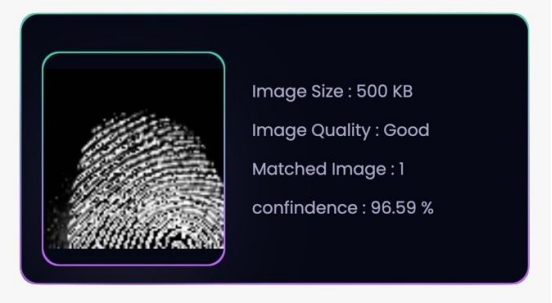
IV. RESULTS

TABLE I COMPARISON OF PREDICTION ACCURACY OF DEEP LEARNING ALGORITHMS

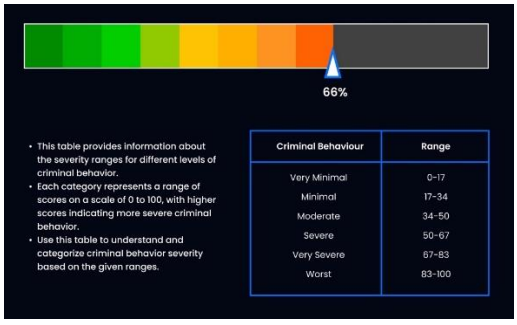
ALGORITHM	ACCURACY
CNN	99.2%
RNN	95%

During the evaluation phase, we carried out a detailed comparison of two deep learning models: Convolutional Neural Network (CNN) and Recurrent Neural Network (RNN). Both models underwent thorough training and testing using a dataset that included fingerprint and handwriting samples from various crime scenes.

Our analysis showed that CNN surpassed RNN, achieving an outstanding accuracy rate of 99.2% in identifying crime suspects. In contrast, RNN exhibited a slightly lower accuracy rate of 95%. The notable variance in accuracy between the two models highlights the superior performance of CNN.



CNN is proficient in processing intricate image data and extracting vital features from fingerprint and handwriting samples. The decision to utilize CNN as the primary model for identifying suspects in criminal investigations is well-founded.



Its exceptional performance in accurately identifying potential suspects from the dataset showcases CNN's ability to analyze complex crime scene information effectively, underscoring its suitability and dependability for law enforcement agencies. By selecting CNN as the main model, our crime detection simulation tool can achieve higher precision and efficiency, leading to more successful crime resolutions. The incorporation of CNN into the tool boosts its overall effectiveness in aiding law enforcement agencies in swiftly capturing suspects, thereby enhancing public safety and security in communities.

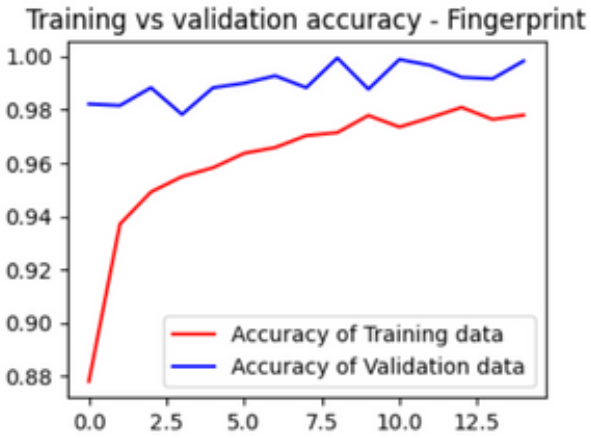


Fig 3. Model Accuracy Plot

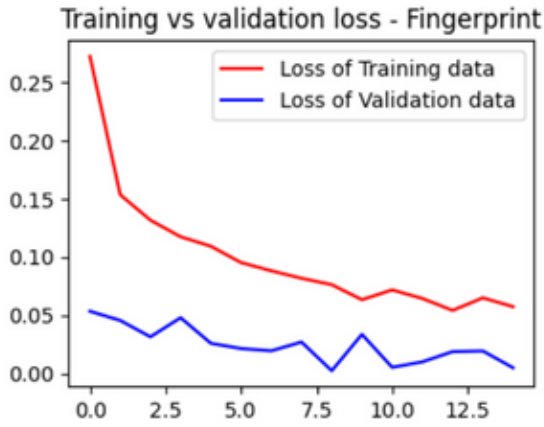


Fig 4. Model Loss Plot

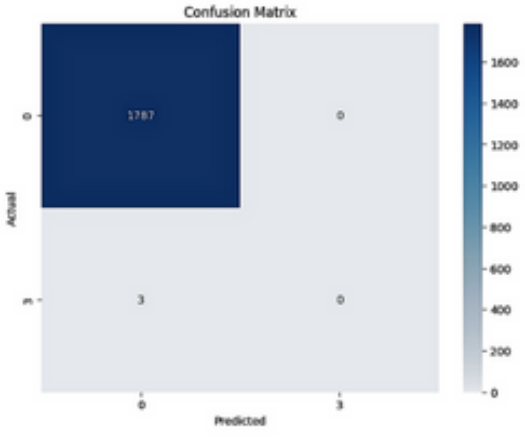


Fig 5. Confusion matrix

V. CONCLUSION

The advanced crime detection simulation tool stands as a major breakthrough in combating the increasing crime rates in India. By incorporating cutting-edge technologies like handwriting and fingerprint analysis, along with sophisticated machine learning algorithms such as Convolutional Neural Networks (CNNs), the tool demonstrates exceptional capability in swiftly and accurately identifying potential suspects. Its user-friendly interface facilitates easy adoption for law enforcement personnel, allowing for widespread use. By promoting a proactive crime detection approach, the tool enables law enforcement agencies to efficiently resolve criminal cases, contributing to safer communities. In the face of escalating crime issues, this tool emerges as a vital advancement in crime detection, set to significantly enhance public safety nationwide.

The successful integration of the advanced crime detection simulation tool signifies a noteworthy achievement in law enforcement and crime investigation, leveraging CNNs and advanced machine learning algorithms.

VI. REFERENCES

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