GAN BASED FACIAL RECONSTRUCTION USING TEXTUAL DESCRIPTION: A FORENSIC APPROACH

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College : *Global Academy of Technology, Bengaluru*
Branch : *Department of Computer Science and Engineering*
Guide : *Prof. R.C. Ravindranath*
Student(s) : *Mr. Devaraja P*
Mr. Dhiraj C
Mr. G K Dhanush

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Introduction:

Facial reconstruction from textual descriptions is a crucial task in forensic investigations, helping law enforcement agencies identify suspects when only descriptive information is available. Traditional methods rely on hand-drawn sketches, which are time-consuming and subject to human interpretation errors. Advances in artificial intelligence, particularly Generative Adversarial Networks (GANs), have enabled the generation of realistic facial images from structured data or textual inputs. This project proposes a novel approach that combines Attention-based GANs (ATTGANs) with Small Language Models (SLM) to reconstruct high-quality facial images from free-form textual descriptions. By extracting facial attributes using regex and natural language processing techniques, and performing similarity-based matching with FAISS, the system assists investigators in rapidly narrowing down potential suspects. The project contributes to AI-driven forensic applications, offering a scalable, accurate, and interactive solution for criminal identification.

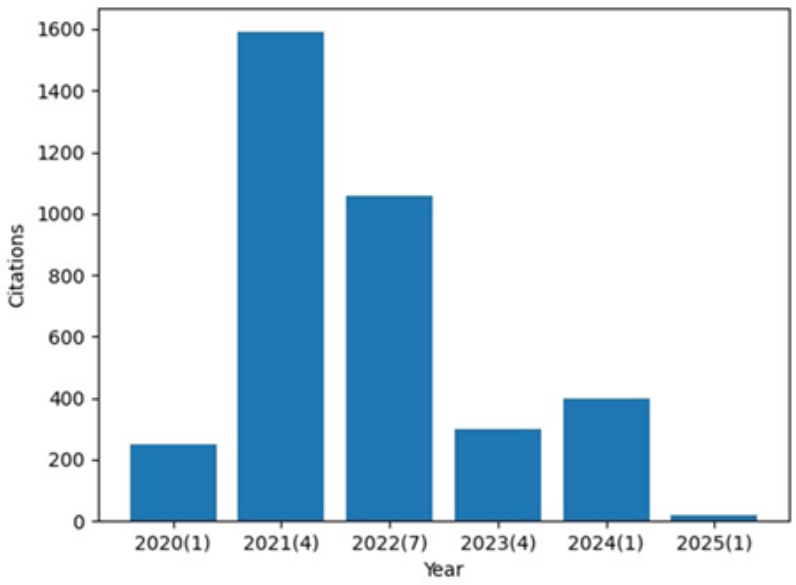

Figure 1:Year vs Citations

Objectives:

1. Develop a Django-based interactive system to collect textual suspect descriptions and extract structured facial attributes using regex and NLP techniques.
2. Generate realistic suspect facial images from the extracted attributes using Attention-based GAN (ATTGAN) and refine them with SLM for improved clarity and realism.
3. Compare the enhanced facial images with a facial database using FAISS similarity search to retrieve the top-K closest matching suspects efficiently.
4. Support forensic investigation and contribute to AI/ML research by enabling efficient suspect face reconstruction, visual output generation, and similarity-based identification.

Methodology:

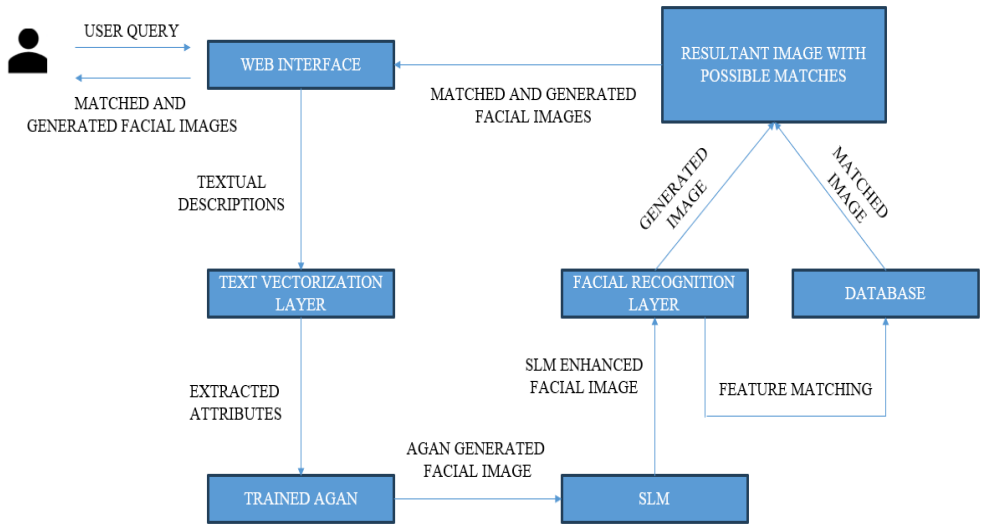

Figure 2: Architecture

The proposed system is an AI-based forensic framework that converts written suspect descriptions into realistic facial images and identifies possible matches from a facial database. By combining text analysis, image generation, enhancement, and similarity-based recognition, it supports faster and more effective suspect identification.

- **User Input & Attribute Extraction -** A Django-based web interface is used to collect free-form textual suspect descriptions. A regex-based extraction function processes the text to identify and convert key facial attributes into a structured format.
- **Facial Image Generation & Enhancement -** The extracted attributes are fed into the Attention-based GAN (ATTGAN) to generate an initial facial image. This image is then refined using the Small Language Model (SLM) to improve realism and make it suitable for recognition.
- **Facial Recognition & Matching -** The enhanced image is compared against a stored facial database using a FAISS similarity search. The system retrieves the top-K closest matches based on similar distance scores.

Result and Conclusion:

Result

The developed system successfully converts textual suspect descriptions into meaningful facial attributes. The web-based interface makes it easy for investigators to enter suspect details quickly and clearly. Using regex and NLP techniques, the system is able to extract important facial features from the given description. These extracted features are then used to generate an initial suspect face image. The Attention-based GAN produces a facial image that reflects the major attributes provided by the user. To improve the visual realism and forensic quality, the generated image is further enhanced using Stable Diffusion Img2Img. This enhancement step produces clearer, sharper, and more realistic facial outputs. The final reconstructed face is then compared with the suspect image database. For this, FAISS similarity search and cosine similarity are used to identify the closest matches. The system retrieves the top matching identities efficiently from the database. This helps investigators narrow down possible suspects in less time. An important advantage of the system is its real-time feedback and iteration capability. Investigators can refine or update facial features if the generated image does not fully match their expectations. This iterative process improves the accuracy and usefulness of the reconstructed suspect image. Overall, the system delivers an effective AI-based forensic solution for face generation, enhancement, and suspect matching.

Conclusion

The proposed system provides a complete AI-driven approach for forensic face reconstruction and recognition. It transforms textual suspect descriptions into realistic facial images with the help of advanced generative models. By combining image enhancement and database matching, the system improves the accuracy of suspect identification. The real-time refinement feature makes the system more flexible and practical for investigators. Thus, the project can serve as a valuable support tool for law enforcement during early-stage criminal investigations.

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Future Scope:

Future work should focus on improving both face generation and suspect matching accuracy. This can be done by training the Attention GAN on a larger and more diverse dataset, improving its architecture with additional convolution layers, and testing stronger alternatives such as other GANs or diffusion models. The system can also be improved by using LLMs for better attribute extraction from text, upgrading hardware for faster training and deployment, and strengthening the recognition module for more accurate matching with forensic databases.