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Recognipro: Recognition And Construction Of Forensic Facial Sketches

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Abstract

In recent years, there has been a notable surge in interest surrounding forensic face sketch construction and recognition, primarily due to their crucial role in criminal investigations. Within the realm of forensic science, it is evident that hand drawn face sketches are still very limited and time consuming when it comes to using them with the latest technologies used for recognition and identification of criminals. The construction of accurate facial sketches from description of eyewitness is a critical step in the investigation process. This research explores using computer vision and deep learning to accurately match hand-drawn face sketches to digital images. Deep learning can help overcome the large differences between sketches and photos. The proposed method involves training a model on a large dataset of face images and corresponding sketches, enabling it to generate sketches from facial images and match sketches with corresponding images accurately. The goal is to develop a system that identify individuals from sketches as accurately as possible to assist law enforcement. The outcomes of this study help in advancing the field of facial recognition and reliable sketch matching would provide law enforcement and forensics with a valuable new tool for identification when robust photo evidence is not available.

Introduction

In the complex and ever-evolving sphere of criminal justice, the process of identifying and apprehending a criminal can be significantly expedited by the use of a facial sketch. This sketch is typically drawn based on the description provided by an eyewitness who has had the opportunity to observe the perpetrator. However, as we continue to advance into the modern era, the traditional method of hand-drawing a sketch has proven to be less effective and more time-consuming when it comes to matching and identifying from existing or real-time databases.

Over the years, a multitude of techniques have been proposed with the aim of transforming hand-drawn face sketches into a format that could be used to automatically identify and recognize a suspect from a police database. Despite the innovative thinking behind these techniques, they often fell short of delivering the desired level of precision. This lack of precision could potentially lead to misidentification, thereby compromising the integrity of the criminal justice process.

In response to these challenges, applications were developed with the intention of creating composite face sketches. However, these applications were not without their limitations. For instance, they often had a restricted facial features kit, which limited the range of features that could be included in the sketch. Moreover, the created suspect face often had a cartoonish appearance, which detracted from the realism of the sketch and made it less useful for identification purposes. These limitations made it challenging to use these applications effectively and achieve the desired results and efficiency.

These challenges and needs served as a catalyst for us, inspiring us to conceive an application that would not only provide a selection of individual features like eyes, ears, mouth, etc. to create a face sketch, but also allow users to upload hand-drawn individual features onto the platform. These features would then be converted into the application's component set. This innovative approach would make the created sketch much more similar to the hand-drawn sketch, thereby making it easier for law enforcement departments to adopt the application.

Our application would also offer a unique feature that would enable the law enforcement team to upload previous hand-drawn sketches. This feature would allow the platform to identify and recognize the suspect using a highly efficient deep learning algorithm and cloud infrastructure provided by the application. The machine learning algorithm would learn from the sketches and the database to suggest to the user all the relatable facial features that could be used with a single selected feature. This feature would not only reduce the time frame required to create a sketch but also increase the efficiency of the platform.

This innovative approach represents a significant advancement in the field of criminal identification and justice. By leveraging the power of technology, we can make the process of identifying and apprehending criminals more efficient and accurate, thereby contributing to a safer society. Our application is not just a tool; it is a step towards a more secure future. It is our hope that this application will serve as a valuable asset to law enforcement agencies worldwide, aiding them in their noble mission to uphold justice and maintain peace.

Methodology:

This his application operates in two distinct stages.

1) Face Sketch Construction: The user flow is depicted by a flowchart, which guides the platform in creating an accurate face sketch based on the provided description. The dashboard is designed with simplicity in mind, eliminating the need for professional training before using this platform. This saves both time and resources of the user.

Creating a face sketch could become complex if all the face elements are presented simultaneously and in a disorganized manner. This could make the process difficult for the user and complicate the construction of an accurate face, which would contradict the objectives of the proposed system. To address this issue, we decided to organize the face elements based on the face category they belong to, such as head, nose, hair, eyes, etc. This makes it much easier for the user to interact with the platform and construct the face sketch. This feature is available in the column on the left of the Canvas on the dashboard. Clicking on a face category allows the user to access various other face structures.

When the user clicks on a particular face category, a new module opens to the right of the canvas, allowing the user to select an element from the options of face elements to construct a face sketch. This option can be selected based on the description provided by the eyewitness.

The selected elements are displayed on the canvas and can be moved and placed according to the eyewitness's description to create a better and more accurate sketch.

The final module includes options to enhance the use of the dashboard. For instance, if the user selects an element that should not have been selected, this can be corrected using the option to erase that element, which can be visible whilst deciding on the face class from the left panel.

We also have a button to save the constructed face sketch, saving the face sketch as a PNG file for easier future access. This could be any location on the host PC or on the server, depending on the user.

2)Facial Sketch Recognition: The module, primarily designed to operate on the User’s server for security reasons, is initiated. The user first accesses either the hand-drawn sketch or the face sketch created on our platform and saved on the host machine. Subsequently, the opened face sketch is uploaded to the User's server, which houses the recognition module. This ensures that the process and the data of the record remain untampered, secure, and accurate.

Once the sketch is uploaded onto the server, the algorithm begins by tracing the sketch image. This is done to learn the features in the sketch and map these features, as depicted in the figure below. The aim is to match these features with those of the face photos in the records.

After the sketch has been mapped and matched with the records, and a match has been found, the platform displays the matched face. Alongside the matched face, the platform also displays the similarity percentage and other details of the person from the records. The platform's display of all this information, along with the matched person, is shown in the figure below. This comprehensive display of information aids in the

identification process, making it more efficient and accurate.

System Design

System architecture

This diagram outlines a system where forensic experts can either input an existing rough sketch or create one using predefined facial features. Sketches can be uploaded to utilize the face recognition module. The system then uses this sketch to search for potential matches in a law enforcement database, providing a clearer sketch or image as an output

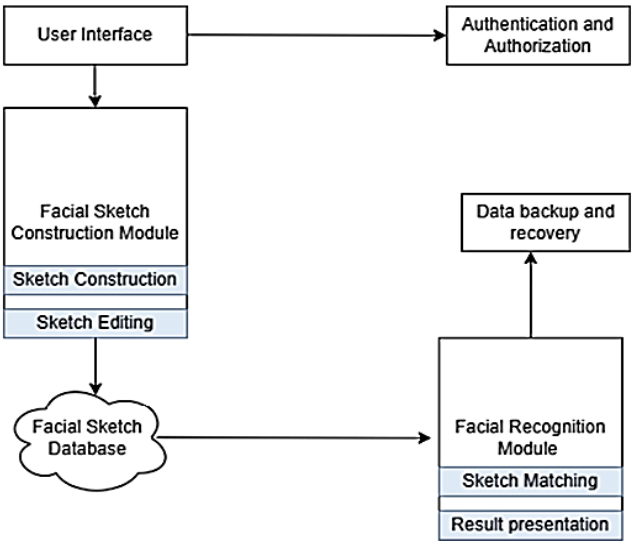


Fig 1: Set up for optical measurement

Technology:

Deep learning for facial sketch recognition:

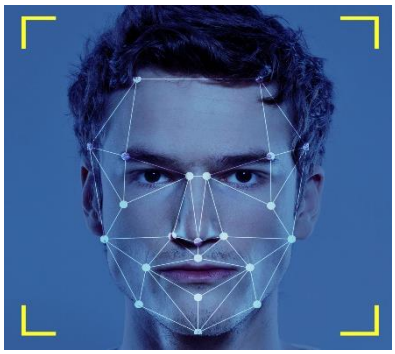
Face recognition involves identifying and verifying individuals in photographs based on their facial features. Although humans can easily perform this task, even when faced with varying lighting conditions or changes due to age or accessories, it remains a challenging problem in computer vision. Recently, deep learning methods have made significant strides by leveraging large face datasets to learn compact and informative representations. These modern models now match or even surpass human face recognition capabilities. We commonly refer to this as the problem of automatic 'face recognition,' which applies to both still photographs and video streams.

Traditional face recognition methods struggle with sketch recognition because of the significant modality variations between face photos and sketches.

Sketches lack fine details, shading, and color information, making them inherently different from photos. Deep learning models can help bridge this gap by learning discriminative features from both modalities**.**

1. Deep Convolutional Neural Networks (DCNNs):
    - DCNNs are specialized neural networks designed to automatically learn hierarchical features from data.
    - They consist of multiple layers, including convolutional layers that learn local patterns and pooling layers that down sample the features.
    - DCNNs excel at capturing complex and abstract representations, making them suitable for tasks like facial sketch recognition.
2. Learning Discriminative and Invariant Features:
    - DCNNs learn features that are both discriminative (help distinguish between different classes) and invariant (robust to variations).
    - By training on large datasets, DCNNs can discover relevant patterns and generalize well to unseen examples.
    - Invariant features are crucial for recognizing faces across different conditions (e.g., lighting, pose, and expression).
3. Training Process:
    - Activation Function: Each neuron in a DCNN applies an activation function (e.g., ReLU) to its input. This introduces non-linearity and allows the network to learn complex mappings.
    - Loss Function: The loss function quantifies the error between predicted and actual labels. Different tasks (classification, regression) require specific loss functions (e.g., cross-entropy, mean squared error).
    - Optimization Algorithm: Stochastic Gradient Descent (SGD) is commonly used. It adjusts the model's weights to minimize the loss function.
    - Backpropagation: Errors are propagated backward through the network to update weights. The gradient of the loss with respect to each weight is computed.
    - Weight Modification: Weights are adjusted to reduce the gradient of the loss function. This fine-tunes the network to improve predictions.

Deep learning for facial sketch recognition involves training DCNNs on large datasets, using appropriate loss functions, and optimizing weights to learn discriminative and invariant features. The goal is to recognize faces



accurately even when presented as sketches.

Conclusion

The Project 'RecogniPro: Recognition and Construction of Forensic Facial Sketches' is being designed, developed and finally will be tested keeping the real-world scenarios from the very first splash screen to the very last display to fetch information from the statistics maintaining security, privateness and accuracy as the important thing element in each scenario. The platform is expected to display a tremendous result on Security point of view by blocking the platform use if the MAC Address and IP Address on load does not match the credentials related to the person with the details inside the database and later the OTP device proved its cap potential to limitation using formerly generated OTP or even producing the new OTP whenever the OTP web page is reloaded or the person attempts to relog withinside the platform. The platform may also display appropriate accuracy and velocity at the same time as face cartoon production and popularity process, is anticipated to provide a median accuracy of extra than 90% with a confidence level of 100% when tested with various test cases, test scenario and data sets, which means a very good rate according to related studies on this field.

References

[1] V. Rodin and A. Maksimov, "Style transfer effectiveness for forensic sketch and photo matching," 2023 IX International Conference on Information Technology and Nanotechnology (ITNT), Samara, Russian Federation, 2023.

[2] Thakare, A., Phalke, N., Phadnis, O., Ansari, T., & Gaikwad C. (2023). Implementation of digital forensics face sketch recognition using fusion based deep learning convolutional neural network. International Research Journal of Modernization in Engineering Technology and Science, .https://www.irjmets.com/uploadedfiles/paper/issue_5_may_2023/40399/final/fin_irjmets1685198661.pdf

[3] N. N. Bahrum, S. Setumin, E. A. Saidon, N. A. Othman and M. F. Abdullah, "Forensic Face Sketch Recognition based on Pre-Selected Facial Regions," 2022 IEEE 12th International Conference on Control System, Computing and Engineering (ICCSCE), Penang, Malaysia, 2022.

[4]Hassan, M., Iqbal, M. M., Qayyum, H., Nawaz, M., & Ali, F. (2022). Sketch-based face recognition using deep learning. Webology, 19(3), 267-279. https://www.webology.org/data-cms/articles/20220901115620amwebology%2019%20(3)%20-%20267.pdf

[5] L. Fan, X. Sun and P. L. Rosin, "Siamese Graph Convolution Network for Face Sketch Recognition: An application using Graph structure for face photo-sketch recognition," 2020 25th International Conference on Pattern Recognition (ICPR), Milan, Italy, 2021.

[6] N. I. Ahmad Sabri and S. Setumin, "One-Shot Learning for Facial Sketch Recognition using the Siamese Convolutional Neural Network," 2021 IEEE 11th IEEE Symposium on Computer Applications & Industrial Electronics (ISCAIE), Penang, Malaysia, 2021.

[7] Costa, R., Galdran, A., Sappa, A. D., & Vieriu, R.-L. (2020). Evaluating the performance of face sketch generation using generative adversarial networks. ScienceDirect, 104, 103204. https://www.sciencedirect.com/science/article/abs/pii/S0167865519302831

[8] Fan, L. (2020). Face sketch recognition using deep learning (Doctoral dissertation, Cardiff University). ORCA - Cardiff University. https://orca.cardiff.ac.uk/139410/1/2020fanlphd.pdf

[9] Tetarave, R., Karia, P., Chauhan, K., & Chauhan, N. (2019). CHEHRA: An application for forensic face sketch construction and recognition. International Journal of Advanced Research in Science, Communication and Technology, 2(1). https://ijarsct.co.in/Paper3179.pdf

[10] ScienceGate. (n.d.). Face sketch recognition latest research papers. https://www.sciencegate.app/keyword/406974

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