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REPLENISHING THE FACIAL FEATURES BEHIND THE MASK USING UNET

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Abstract - Replenishing the facial features behind the mask using U-Net is an innovative solution addressing the challenges posed by the widespread use of face masks. Leveraging state-of-the-art technologies, the system employs Haar cascade classifiers to identify faces, distinguishes masked and unmasked faces through a specialized convolutional neural network, and employs a U-Net model for real-time mask segmentation and completion. Our project aims to enhance personal connections and restore face recognition in an authentication scenario. It contributes a seamless and effective unmasking experience in real-world scenarios.

***Key Words*:** *Mask segmentation, U-Net architecture, Haar cascade classifiers, Convolutional neural networks*.

1.INTRODUCTION

Imagine navigating a world where everyone wears masks due to health protocols. While masks are essential for safety, they obscure facial features, making it challenging to recognize others. There are places like airports and examination centres where we need to remove masks for authentication purposes. However, in some situations, removing the mask may not be feasible. In such cases, rather than removing the mask, we can reconstruct the face behind it by infilling that region.

At the heart of our approach, lies a sophisticated architecture that encompasses a three-layer CNN for precise mask detection and an EfficientNet_B0 encoder-based U-Net for accurate mask segmentation and completion. By seamlessly integrating these components, we aspire to transcend the limitations imposed by face masks, empowering individuals and organizations to navigate social interactions and security protocols with confidence and ease. This approach simplifies authentication in the scenarios which mask removal is not possible.

The motivation behind this project stems from the increasing importance of facial recognition technology and the challenges posed by the widespread use of masks. By developing an automated system for unmasking facial images, the project aims to contribute to various applications, including identity verification, security surveillance, and forensic analysis. Additionally, the project seeks to advance the field of computer vision by addressing a complex and relevant real-world problem with state-of-the-art techniques.

2. PROPOSED SYSTEM

We propose a real-time face mask unmasker which identifies the faces using a Haar cascade classifiers, Identifies if the face is masked or not using a specialized convolutional neural network, segments the mask using simple heuristics and uses a simple U-Net model to complete the remainder. To train our model we use publicly available CelebA dataset. The project aims to mitigate the impact of mask-wearing on personal connections and the ability to identify individuals by providing a real-time solution for revealing faces underneath masks.

3. IMPLEMENTATION

Face Detection: Utilized a pre-trained face detection model to locate the face within the input image to extract bounding box or facial landmarks representing the detected face.

Mask Classification: Applied a mask classification model to determine whether the detected face is wearing a mask or not using specialized convolutional neural networks.

Mask Segmentation: If a mask is detected on the face, apply a segmentation algorithm to delineate the mask region from the rest of the face.

Face Reconstruction: For the masked face, reconstruct the unmasked facial region by inpainting the masked area with plausible facial features. Utilize image inpainting techniques to synthesize missing facial details based on surrounding pixels.

Integration and Output: Integrate the outputs of the face detection, mask classification, mask segmentation, and face reconstruction steps to generate the final unmasked image. Output the resulting image with the face unmasked.

4. SYSTEM ARCHITECTURE

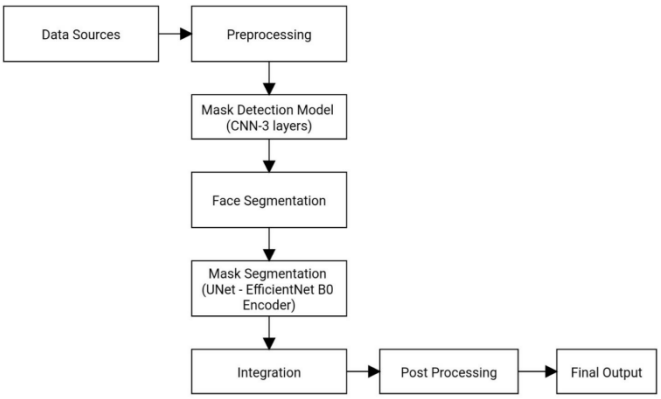

Fig -1: System Architecture

Step 1: Receive input images or video frames containing individuals with masked or unmasked faces.

Step 2: Utilize algorithms to locate faces within the input data. Identify facial features such as eyes, nose, and mouth. Output bounding boxes or facial landmarks representing detected faces.

Step 3: Analyse each detected face to determine mask presence. Apply pre-trained models to classify faces as masked or unmasked. Assign labels indicating the presence or absence of masks.

Step 4: Segment unmasked faces from the background. Isolate facial regions containing eyes, nose, and mouth. Generate masks representing segmented facial features.

Step 5: Extract features from unmasked faces for recognition. Compare extracted features with known identities in the database. Determine the closest match using similarity metrics.

Step 6: Visualize processed results for each input image or video frame. Overlay bounding boxes or facial landmarks on detected faces. Display labels indicating mask presence or absence. Highlight segmented facial regions for unmasked faces. Present recognized identities or labels associated with unmasked faces.

Step 7: Provide an interface for users to interact with the system. Allow users to submit input data and view processed results. Enable configuration of system parameters and processing options.

Step 8: Train and update machine learning models used within the system. Preprocess data, train models, and evaluate performance. Implement mechanisms for model versioning and checkpointing.

Step 9: Capture logs and metrics related to system performance. Monitor resource utilization and processing throughput.

5. CONCLUSIONS

Replenishing the Facial Features Behind the Mask using U-Net stands as a beacon of innovation and progress in overcoming the challenges posed by widespread mask usage. By harnessing advanced technologies like CNNs and U-Net models, we pave the way for seamless interactions and reliable authentication processes. As we envision a future where masks no longer hinder human connection or security measures, our commitment to innovation fosters a safer, more inclusive environment where identity and communication thrive unencumbered

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