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Face Mask Recognition Using RCNN

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Abstract- Corona Virus is the latest pandemic that forced an international health emergency. It spreads mainly from person to person through airborne transmission. Many countries have imposed compulsory face mask policies in public areas as a preventive action. However, some people still do not wear masks in public areas, which might lead to infection of themselves or others. Manual observation of the face mask in crowded places is a tedious task. Therefore, automatic detection of the wearing of face masks may help global society, but research related to this is limited.In this paper, we propose a Mask-RCNN use two novel methods to achieve this. First, to detect mask region from the face using RPN and to extract rich context features and focus on crutial face mask related regions, we propose a novel residual residual context attention module (RCAM). Second, to learn more discriminating features for face with and without masks. This technique is capable of recognizing masked and unmasked faces to help monitor safety breaches, facilitate the use of face masks, and maintain a secure working atmosphere.

Keywords- COVID-19, Deep Learning, Face Mask Detection, Feature Extraction, Pre-processing, Segmentation.

I. INTRODUCTION

Since the outbreak of COVID-19 (Corona virus) was declared a pandemic early March 2020, people across the globe have rushed to their local pharmacy to buy surgical masks. The novel corona virus with pathogen name SARS-CoV-2 spreads through the mouth when an infected person coughs or sneezes.

The World Health Organization (WHO) states that the new corona virus spreads much faster than other corona viruses such as SARS and MERS. Face masks can help to stop the spread of corona virus (COVID-19), especially in places where it is difficult to socially distance. Face masks are one tool utilized for preventing the spread of disease.

They may also be called dental, isolation, laser, medical, procedure, or surgical masks. Face masks are loose-fitting masks that cover the nose and mouth, and have ear loops or ties or bands at the back of the head.

Consider wearing a face mask when you are sick with a cough or sneezing illness (with or without fever) and you expect to be around other people. The face mask will help protect them from catching your illness. Healthcare settings have specific rules for when people should wear face masks. There are many different brands and they come in different colours. It is important to use a face mask approved by the FDA. When worn properly, all types of face masks help to reduce the spread of COVID-19 (corona virus). If your face mask does not completely cover your nose and mouth, it will not protect you or anyone else.

II. PROJECT OBJECTIVE

Therefore, recognizing and authenticating people wearing masks will be a long-established research area, and more efficient methods are needed for real-time MFR.T Machine learning has made progress in MFR and has significantly facilitated the intelligent process of detecting and authenticating persons with occluded faces. The objective of the project is to propose, a deep learning approach to obtain highly discriminative features for face recognition with masked face.

To extract deep features from the informative regions, we have employed CNN as feature extractors. This project works developed for MFR based on deep learning techniques, providing insights and thorough discussion on the development pipeline of MFR systems. State-of-the-art techniques are introduced according to the characteristics of deep network architectures and deep feature extraction strategies.

III. DEEP LEARNING

Deep Learning is a subset of Machine Learning, which on the other hand is a subset of Artificial Intelligence. Artificial Intelligence is a general term that refers to techniques that enable computers to mimic human behaviour. Machine Learning represents a set of algorithms trained on data that make all of this possible.

1. Deep Neural Networks:
A deep neural network is simply a shallow neural network with more than one hidden layer. Each neuron in the

hidden layer is connected to many others. Each arrow has a weight property attached to it, which controls how much that neuron's activation affects the others attached to it.The word 'deep' in deep learning is attributed to these deep hidden layers and derives its effectiveness from it. Selecting the number of hidden layers depends on the nature of the problem and the size of the data set. The following figure shows a deep neural network with two hidden layers.

The data is fed into the input layer.Each node in the input layer ingests the data and passes it onto the next layer, i.e., the hidden layers. These hidden layers increasingly extract features from the given input layer and transform it using the linear function. These layers are called hidden layers because the parameters (weights and biases) in each node are unknown; these layers add random parameters to transform the data, each of which yields different output. The output yielded from the hidden layers is then passed on to the final layer called the output layer, where depending upon the task, it classifies, predicts, or generates samples.This process is called forward propagation.

In another process called back propagation, an algorithm, like gradient descent, calculates errors by taking the difference between the predicted output and the original output. This error is then adjusted by fine-tuning the weights and biases of the function by moving backward through the layers. Both, the process of forward propagation and back propagation allows a neural network to reduce the error and achieve high accuracy in a particular task. With each iteration, the algorithm becomes gradually more accurate.

2. Applications:

2.1 Deep learning has a plethora of applications in almost every field such as health care, finance, and image recognition. In this section, let's go over a few applications.

2.2 Health care: With easier access to accelerated GPU and the availability of huge amounts of data, health care use cases have been a perfect fit for applying deep learning. Using image recognition, cancer detection from MRI imaging and x-rays has been surpassing human levels of accuracy. Drug discovery, clinical trial matching, and genomics have been other popular health care-based applications.

2.3 Autonomous vehicles: Though self-driving cars is a risky field to automate, it has recently taken a turn towards becoming a reality. From recognizing a stop sign to seeing a pedestrian on the road, deep learning-based models are trained and tried under simulated environments to monitor progress.

2.4 Commerce: Product recommendations has been one of the most popular and profitable applications of deep learning. With more personalized and accurate recommendations, customers are able to easily shop for the items they are looking for and are able to view all of the options that they can choose from. This also accelerates sales and thus, benefits sellers.

2.5 Personal assistant: Thanks to advancements in the field of deep learning, having a personal assistant is as simple as buying a device like Alexa or Google Assistant. These smart assistants use deep learning in various aspects such as personalized voice and accent recognition, personalized recommendations, and text generation.

IV. LITERATURE SURVEY

Yoanna Martínez-Díaz, Heydi Méndez-Vázquez have published the paper on face mask recognition that selects three state-of-the-art lightweight CNN face models that were the top-performing in: VarGFaceNet, MobileFaceNet and ShuffleFaceNet.VarGFaceNet consists of an efficient variable group convolutional network based on VarGNet for lightweight face recognition. MobileFaceNet and ShuffleFaceNet have shown competitive performance with respect to high-accurate very deep face models on several benchmarks for unconstrained face recognition. [5]

Meng Zhang,Rujie Liu have proposed a low-cost, accurate mask transfer method for masked face data augmentation is proposed by the consideration of pose and illumination consistency. This method can add the mask from any face image with a mask to any face image without a mask. Qualitative and quantitative experiments are conducted to analyse the effect of wearing face masks on the behaviour of face recognition systems. An AMaskNet is proposed to improve the performance of masked face recognition. A mask-aware similarity matching strategy is proposed for the inference stage, which can be applied to any face recognition scene in which one image with a mask and the other without a mask are present. [6]

Xinqi Fan, Mingjie Jiang have proposed a model to cope with the low feature extraction capability caused by the light-weight model, the author proposed two novel methods to enhance the model's feature extraction process. First, to extract rich context information and focus on crucial face mask related regions, we propose a novel residual context attention module. Second, to learn more discriminating features for faces with and without masks, we introduce a novel auxiliary task using synthesized Gaussian heat map regression. Ablation studies show that these methods can considerably boost the feature extraction ability and thus increase the final detection performance. [7]

Bingshu Wang, Yong Zhao has proposed a two-stage method for WMD. It explores the Faster-RCNN framework with InceptionV2 as a pre detection stage and uses BLS as a verification stage. It is verified to be effective by the combination of two stages. The author developed a deep transfer learning model for the pre defection of wearing masks. Wearing mask is the region of interest (ROI). Detecting those ROIs requires a model that can propose accurate and effective regions. The region proposal network (RPN) introduced by the Faster_RCNN framework can provide a series of candidate regions. [8]

Bin Cue, Jianpeng Hu have proposed the more accurate face detection algorithm RETINAFACE is used as the basic algorithm for mask face detection, and on this basis, the network structure of the RETINAFACE algorithm is improved, and the attention mechanism is introduced to meet the needs of new functions; In this system, we calculate the mask and the key point positions of the face, and the confidence that the mask is worn on different faces is returned to determine whether the person wears the mask in a standard manner. The calculation is fast and accurate, and the algorithm is stable and efficient; for the current popular ones for the face recognition method, we use the DEEPFACE algorithm. [9]

Truong Quang Vinh, Nguyen Tran Ngoc Anh have proposed algorithm for face mask detection in this system utilizes Haar cascade classifier to detect the face and YOLOv3 algorithm to detect the mask.This paper presents a real-time face mask detector which can alarm when detecting a person without wearing a face mask. Moreover, the system can recognize the person who wears a face mask incorrectly, or wear other things except a face mask. [10]

V. METHODOLOGY

1. FMR Data Acquisition:

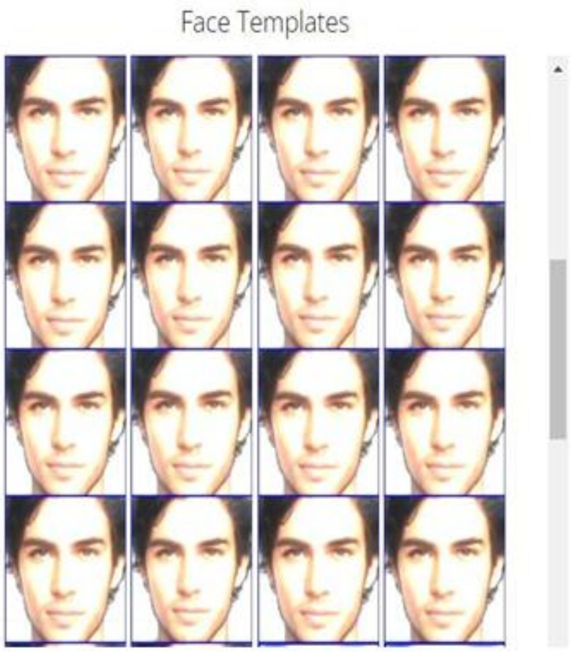

Fig 1. Capturing faces without mask.

It is the basic step of recognition process, aims to collect a large amount of data both in size and type by a variety of ways. We have two phases called FMR Dataset Annotation-Training Phase and Live Facial Expression Video-Testing Phase. In the Training Phase record the video of the face with mask and without mask. Convert this video into frames of about 40 to 60 images. In the Testing Phase, Cameras should be deployed in college campus to capture relevant video. Computer and camera are interfaced and here webcam is used. For every student, one video with mask and no mask of facial features is collected and processed.

Fig 2. Capturing Faces with mask.

2. Training Phase:

Initially Image preprocessing is done to format images before they are used by model training and inference.Initially we Read image, then convert RGB image to Grey Scale image, Resize image in which Original size (360, 480, 3) — (width, height, no. RGB channels) will be Resized to (220, 220, 3), Remove noise (Denoise) to smooth our image to remove unwanted noise. We do this using Gaussian blur and finally we do Binarization. Image binarization is the process of taking a grayscale image and converting it to black-and-white, essentially reducing the information contained within the image from 256 shades of gray to 2: black and white, a binary image.

Region Proposal Network (RPN) generates RoIs by sliding windows on the feature map through anchors with different scales and different aspect ratios.Face detection and segmentation method based on improved RPN. RPN is used to generate RoIs, and RoIAlign faithfully preserves

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the exact spatial locations.These are responsible for providing a predefined set of bounding boxes of different sizes and ratios that are going to be used for reference when first predicting object locations for the RPN.

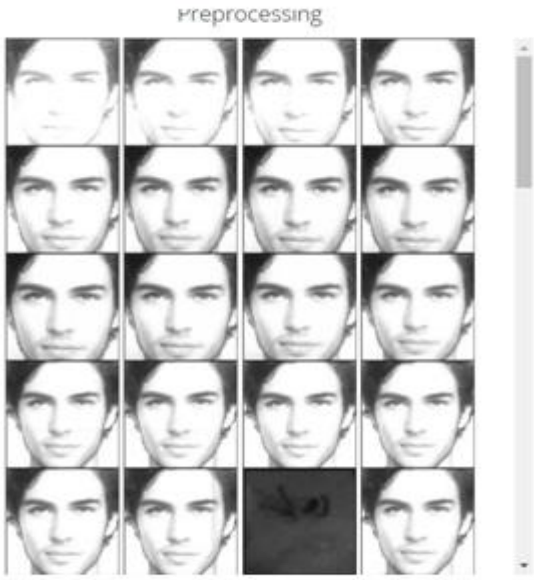

Fig 3. Preprocessing.

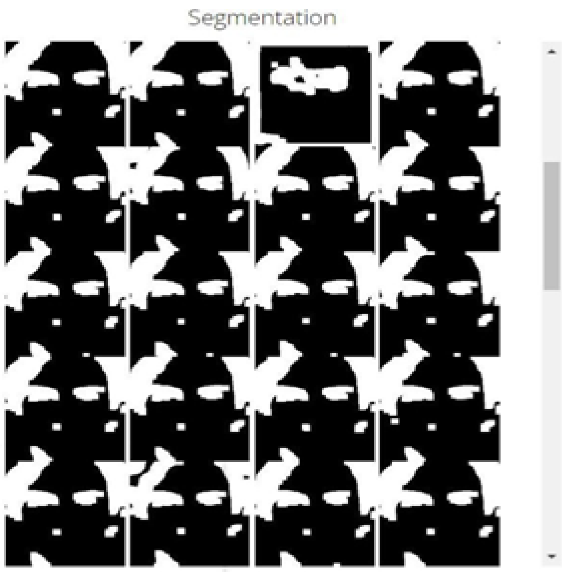

Fig 4. Segmentation.

After acquiring the key frames of faces, a deep feature representation of facial features is generated from a 2D-CNN. These deep learning models have layered architecture that learns features at different layers (hierarchical representations of layered features).This layered architecture allows extracting high-level, medium-level, and low-level features of face expression. Instead of acquiring features from just the last layer, features are extracted from convolution, pooling, and regularization layers.

Mask R-CNN adds a mask branch for predicting segmentation masks on each Region of Interest (RoI), which can fulfil both detection and segmentation tasks. After the face mask detector has been trained, we charge the mask detector, perform face recognition, and then decide whether each face is equipped with or without a mask.

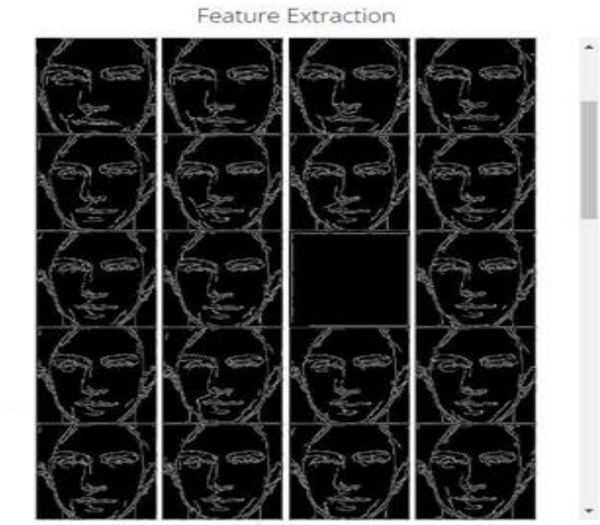

Fig 5. Feature Extraction.

3. Testing Phase:
In this module the matching process is done with trained classified result and test Live Camera Captured Classified file. The Euclidean distance is calculated between 2 ROI points and hence the centre coordinates are transformed into rectangular coordinates to make the bounding box

4. Attendance and Warning System:
Here, warning message is generated to warn the students to wear mask by sending notification to. The attendance is also marked for the students.

Fig 6. Live capturing and detection.

VI. CONCLUSION

Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

Authors are strongly encouraged not to call out multiple figures or tables in the conclusion—these should be referenced in the body of the paper.

VII. ACKNOWLEDGMENT

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