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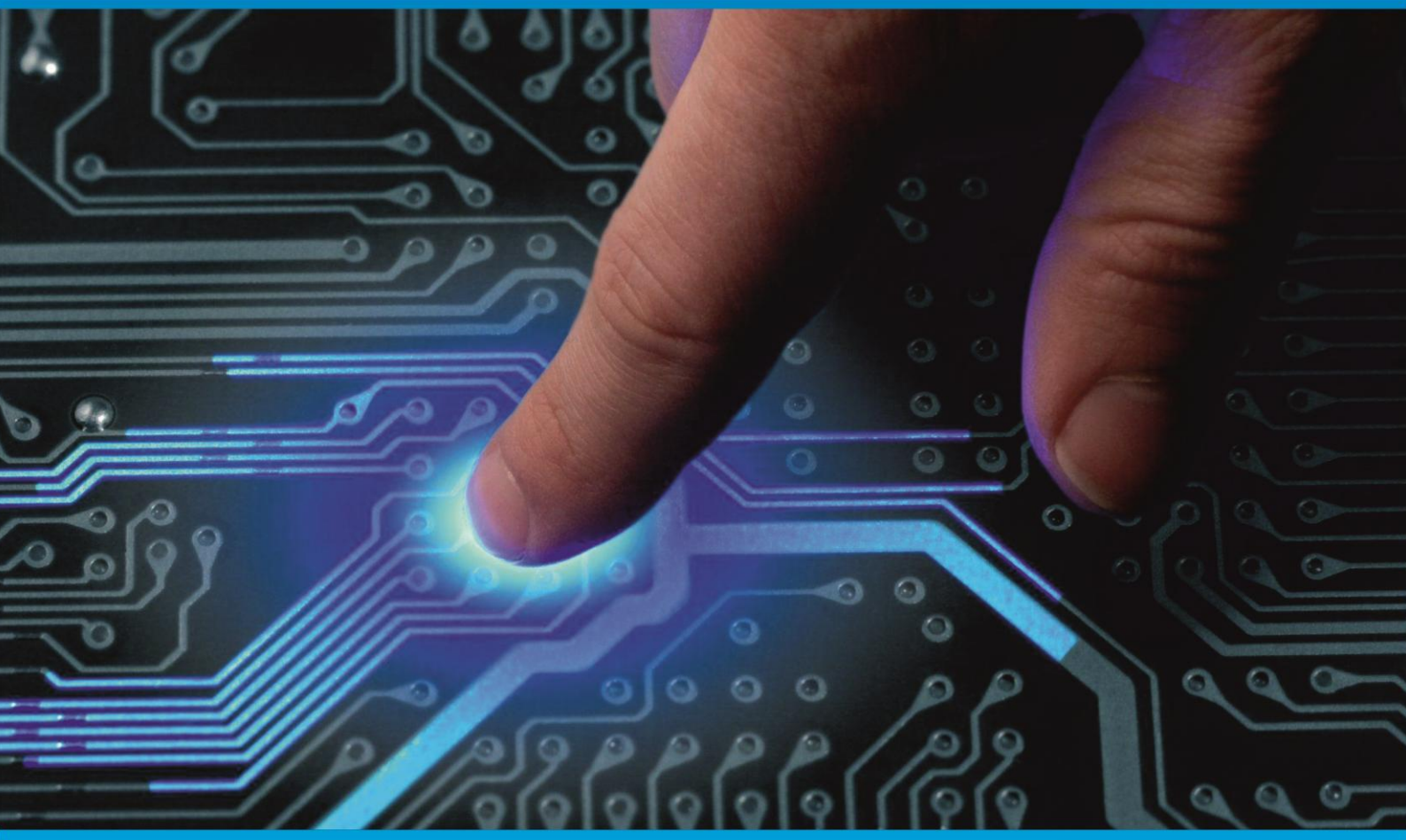

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Face Mask Detection System Using Artificial Intelligence and Machine Learning

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ABSTRACT: The corona virus COVID -19 pandemic is causing a global health crisis so the effective protection methods is wearing a face mask in public areas according to the World Health Organization (WHO). The COVID -19 pandemic forced governments across the world to impose lockdowns to prevent virus transmissions. Reports indicate that wearing face masks while at work clearly reduces the risk of transmission. An efficient and economic application approach of using AI to create a safe environment in a manufacturing setup. A hybrid model using deep and classical machine learning for face mask detection will be presented. Face Mask Detection Application uses existing IP and CCTV cameras to look for the faces and detect people without masks. Using an AI network, the application can recognize if the person is not wearing a mask. The application also allows users to add faces and phone numbers to send them a notification if they are not wearing a mask. In case, the face captured by the camera is unrecognized, the notification is sent to the administrator. we are ,going to use OpenC V to do real-time face detection from a live stream via our webcam. We will use the dataset to build a COVID -19 face mask Detection with computer vision using Python, OpenC V, and Tensor Flo w and Keras.

KEYWORDS*:* Face mask Detection, Artificial intelligence, Machine Learning, TensorFlow, Keras, OpenCV

I. INTRODUCTION

The trend of wearing lace masks in public is rising due to the COVID- 19 corona virus epidemic all over the world. Before Covid -19, People used to wear masks to protect their health from air pollution. While other people are self-conscious about their looks, they hide their emotions from the public by hiding their faces. Scientists proofed that wearing face masks works on impeding COV ID-19 transmission. COVID- 19 (known as corona virus) is the latest epidemic virus that hit the human health in the last century. In 2020, the rapid spreading of COV ID-19 has fiirced the World Health Organization to declare COVID- 19 as a global pandemic. More than five million cases were infected by COVID-19 in less than 6 months across 188 countries. The virus spreads through close contact and in crowded and overcrowded areas.

The corona virus epidemic has given rise to an extraordinary degree of worldwide scientific cooperation. Artificial Intelligence (AI) based on Machine learning and Deep Learning can help to fight Covid-19 in many ways. Machine learning allows researchers and clinicians evaluate vast quantities of data to forecast the distribution of COVID-19, to serve as an early warning mechanism for potential pandemics, and to classify vulnerable populations. The provision of healthcare needs funding for emerging technology such as artificial intelligence, IoT, big data and machine learning to tackle and predict new diseases. In order to better understand infection rates and to trace and quickly detect infections, the AI's power is being exploited to address the Covid-19 pandemic. People are forced by laws to wear lace masks in public in many countries. These rules and laws were developed as an action to the exponential growth in cases and deaths in many areas. However, the process of monitoring large groups of people is becoming more difficult. The monitoring process involves the detection of anyone who is not wearing a face mask.

Here we introduce a mask face detection model that is based on Artificial Intelligence (AI) and Machine learning. Face

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Mask Detection Platform uses Artificial Network to recognize if a user is not wearing a mask. The application can be connected to any existing or new IP mask detection cameras to detect people without a mask. Application users can also add faces and phone numbers to send them an alert in case they are not wearing a mask. If the camera captures an unrecognized face, a notification can be sent out to the administrator. The model is integration between Artificial Intelligence and machine learning techniques with opencv, tensor flow and keras. We have used deep leering for feature extractions and combined it with three classical machine learning algorithms.

Notification Like:
If the face mask Detection application identifies a user that he/she was not wearing a mask, AI alerts are sent with the picture of the person. It allows the application to run automatically and enforces the wearing of the mask.

1.1. Scope:

Factories, Industries, Offices and Government agencies can use this system at the entry gate to allow only the people that are wearing a face mask to reduce the spread of Novel Corona Virus.

1.2. Aim:

Our, aim is to identify whether the person on image/video stream is wearing a f‘ace mask or not with the help AI and Machine Learning

II. RELATED WORK

[1] Detecting Masked Faces in the Wild with LLE-CNN, Shiming Ge, Jia Li, Qiting Ye, Zhao Luo, The Proposal module first combines two pre-trained CNNs to extract candidate facial regions from the input image and represent them with high dimensional descriptors. After that, the Embedding module is incorporated to turn such descriptors into a similarity-based descriptor by using locally linear embedding (LLE) algorithm and the dictionaries trained on a large pool of synthesized normal faces, masked faces and non-faces. In this manner, many missing facial cues can be largely recovered and the influences of noisy cues introduced by diversified masks can be greatly alleviated. Finally, the Verification module is incorporated
to identify candidate facial regions and refine their positions by jointly performing the classification and regression tasks within a unified CNN. Experimental results on the MAFA
dataset show that the proposed approach remarkably out performs 6 state-of-the-arts by at least 15.6%. Detecting Masked Faces in the Wild with LLE-CNNs

[2] Real-Time Face Mask Detection Method Based on YOLOv3, Xinbei Jiang, In this paper, we proposed the ProperlyWearing Masked Face Detection Dataset (PWMFD), which included 9205 images of mask wearing samples with three categories. Moreover, we proposed Squeeze and Excitation (SE)-YOLOv3, a mask detector with relatively balanced effectiveness and efficiency. We integrated the attention mechanism by introducing the SE
block into Darknet53 to obtain the relationships among channels so that the network can focus more on the important feature. We adopted GIoUloss, which can better describe the spatial difference between predicted and ground truth boxes to improve the stability of bounding box regression. Focal loss was utilized for solving the extreme foreground-background class imbalance. Besides, we performed corresponding image augmentation techniques to further improve the robustness of the model on the specific task. Experimental results showed that SE-YOLOv3 outperformed YOLOv3 and other state-of-the-art detectors on PWMFD and achieved a higher 8.6% mAP compared to YOLOv3 while having a comparable detection speed.

[3] How to Correctly Detect Face-Masks for COVID-19 from Visual Information?, Borut Batagelj, n this study, we revisit these common assumptions and explore the following research questions: (i) How well do existing face detectors perform with masked-face images? (ii) Is it possible to detect a proper (regulation-compliant) placement of facial masks? and iii) How useful are existing face-mask detection techniques for monitoring applications during the COVID-19 pandemic? To answer these and related questions we conduct a comprehensive experimental evaluation of several recent face detectors for their
performance with masked-face images. Furthermore, we investigate the usefulness of multiple off-the-shelf deep-learning models for recognizing correct face-mask placement. Finally, we design a complete pipeline for recognizing whether face-masks are worn correctly or not and compare the performance of the pipeline with standard face-mask detection models from the literature. To facilitate the study, we compile a large dataset of facial images from the publicly available MAFA and Wider Face datasets and annotate it with compliant and non-compliant labels. The annotation dataset, called Face-Mask-Label Dataset (FMLD), is made publicly available to the research community.

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[4] Face mask detection using YOLOv3 and faster R-CNN models: COVID-19 environment Sunil Singh, This work proposes a technique that will draw bounding boxes (red or green) around the faces of people, based on whether a person is wearing a mask or not, and keeps the record of the ratio of people wearing face masks on the daily basis. The authors have also compared the performance of both the models i.e., their precision rate and inference time.

[5] RETINAFACEMASK: A FACE MASK DETECTOR, Mingjie Jiang, The proposed RetinaFaceMask is a one-stage detector, which consists of a feature pyramid network to fuse high-level semantic information with multiple feature maps, and a novel context attention module to focus on detecting face masks. In addition, we also propose a novel cross-class object removal algorithm to reject predictions with low confidences and the high intersection of union. Experiment results show that Retina Face Mask achieves state-of-the-art results on a public face mask dataset with 2:3% and 1:5% higher than the baseline result in the face and mask detection precision, respectively, and 11:0% and 5:9% higher than baseline for recall. Besides, we also explore the possibility of implementing RetinaFaceMask with a light-weighted neural network MobileNet for embedded or mobile devices.

III. PROPOSED SYSTEM

A face mask is mandatory in many geographies, offices, Govt. agencies, stores/malls, public transportation, holy places, and in almost all the areas. Some of the governments already made it a rule and imposed fines.

- It is the responsibility of owners/ department heads to make sure that people are wearing masks in public places, if not take the appropriate actions.

a) Monitoring every person in a crowd and ask him to wear a mask is a difficult task

b) At the same time identifying and analyzing how many people are wearing a mask, in how much time, in which location the violation is happening is a very challenging task for naked eyes

c) Identifying people pretending that they are wearing masks

d) It is also difficult to deal with violators without proofs

Artificial intelligence provides a solution to all the challenges, Face mask identification software helps in identifying the persons

1. - Who are partially or fully not wearing the masks
2. - Where and how much time they are without a mask
3. - Advise them on their local language
4. - Identify the violators

Two-Phase COVID-19 Face Mask Detection

To a face mask Detection make working, need to break into two distinct phases, each with its respective sub-steps (as shown by **Figure below**):

1. **Training:** Here it's focused on loading the face mask detection dataset from disk, training a model on this dataset, and then serializing the face mask Detection to disk
2. **Deployment:** Once the face mask Detection is loaded, then the next thing is loading the mask Detection, performing face detection, and then classifying each face as with mask or without mask

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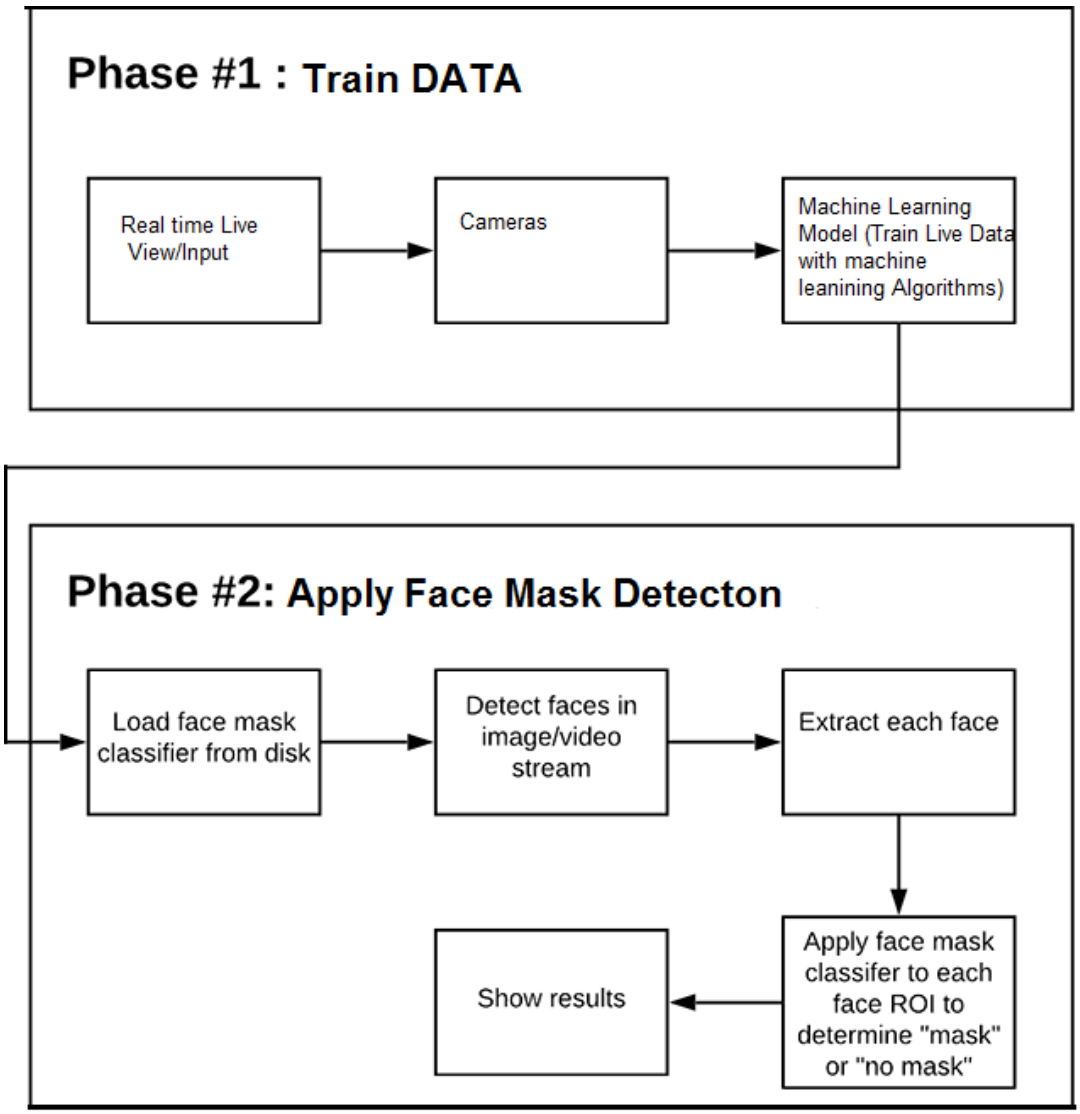

Fig 1: System Architecture

Implementing our COVID-19 face mask Detection

Face Mask Detection system uses Artificial Network to recognize if a person captured on camera is wearing a mask or not. This technology can be integrated into any existing or new IP cameras to detect people without a mask. If the camera captures a face without any mask, a notification can be sent out to the administrator. This solution works irrespective of Gender, Age, Close view, longer view, Front or Side views, sitting or standing positions, different types of masks, etc., this solution can be integrated with existing solutions like CCTV, access management, Drones, etc.

- In the present situation of Covid19 wearing a face mask is an essential precaution to be taken.
- Using an AI network, the system can recognize whether a person is wearing a mask or not.
- A face mask detection system can be used in public areas where there is a chance of people gathering in groups.
- The AI-based system identifies whether a person is wearing a face mask or not and indicates it with a message pop-up

Data at Source

The majority of the images were augmented by OpenCV. The set of images were already labeled “mask” and “no mask”. The images that were present were of different sizes and resolutions, probably extracted from diff'erent sources or from machines (cameras) of different resolutions.

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Data preprocessing

Preprocessing steps as mentioned below was applied to all the raw input images to convert them into clean versions, which could be fed to a neural network machine learning model.

1.Resizing the input image.
2.Applying the color filtering (RGB) over the channels.
3.Scaling / Normalizing images us ing the standard mean of PyTorch build in weights.
4.Center cropping the image.
5.Finally Converting them into tensors.

Deep Learning Frameworks
To implement this deep learning network we have the following options.

- Tensor Flow
- Keras
- PyTorch
- Catree

We are using the PyTorch because it runs on Python, which means that anyone with a basic understanding of Python can get started on building their deep learning models, and also it has the wing advantage compared with Tensor Flow
1. Data Parallelism

2. It looks like a Framework.

Face Mask Detection in webcam stream

The flow to identify the person in the webcam wearing the face mask or not. The process is two-fold.

1. To identify the faces in the webcam 2.Classify the faces based on the mask Identify the Face in the Webcam

To identify the faces a pre-trained model provided by the OpenCV framework was used. The model was trained using web images. OpenCV provides 2 models for this face Detection:
1. Floating-point 16 version of the original Caffe implementaöon.
2.8 bit quantized version using Tensor flow The Caffe model in this face mask Detection. There has been a lot of discussion around deep learning based approaches for person detection. This encouraged us to come up with our own algorithm to solve this problem. Our work on face mask detection comprises of data collection to tackle the variance in kinds of face masks worn by the workers. The face mask detection model is a combination of face detection model to identify the existing faces from camera feeds and then running those faces through a mask detection model.

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Fig 2: Detection of "Mask" and "No Mask"

Advantages:

1. **Hospitals -** Utilizing Face Mask Detection System, Hospitals can monitor & advise if any visitor or staff is wearing masks during their shift or not. If any health worker is found without a mask, they will receive a notification with a reminder to wear a mask, and visitors will be advised to wear a mask. Also, if quarantine people who are required to wear a mask, the system can keep an eye and detect if the mask is present or not and send notification automatically or report to the authorities.
2. **Offices -** The Face Mask Detection System can also be utilized at office premises to detect if employees are keeping safety standards at work. It monitors through all the employees & staff without masks and sends them a warning to wear a mask. Also, the reports can be downloaded or sent an email at the end of the day to capture people who are not complying with the regulations or the requirements.
3. **Airports -** The Face Mask Detection System can be implemented at airports integrated with the security cameras to detect travellers without masks. Face data of travellers can be captured in the system at the entrance. If a traveller is found to be without a face mask, their picture is sent to the airport authorities so that they could take quick action. If the person's face is already stored, like the face of an Airport worker, it can send the alert to the worker's phone directly.

IV. CONCLUSION

As the technology are blooming with emerging trends the availability so we have novel face mask Detection which can possibly contribute to public healthcare. The architecture consists of Mobile Net as the backbone it can be used for high and low computation scenarios. In order to extract more robust features, we utilize transfer learning to adopt weights from a similar task face detection, which is trained on a very large dataset. We used OpenCV, tensor flow, keras , Pytorch and CNN to detect whether people were wearing face masks or not. The models were tested with images and rea1-time video streams. The accuracy of the model is achieved and, the optimization of the model is a continuous process and we are building a highly accurate solution by tuning the hyper parameters. This specific model could be used as a use case for edge analytics. Furthermore, the proposed method achieves state-of-the-art results on a public face mask dataset. By the development of face mask detection we can detect if the person is wearing a face mask and allow their entry would be of great help to the society.

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