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Innovative Approaches To Face Mask Detection: A Comprehensive Review

Face Mask Detection Software

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Abstract: COVID-19 pandemic has rapidly affected our day-to-day life disrupting world trade and movements. Wearing a protective face mask has become a new normal. In the near future, many public service providers will ask the customers to wear masks correctly to avail of their services. Therefore, face mask detection has become a crucial task to help global society. This paper presents a simplified approach to achieve this purpose using some basic Machine Learning packages like TensorFlow, Keras, OpenCV. The proposed method detects the face from the image correctly and then identifies if it has a mask on it or not. As a surveillance task performer, it can also detect a face along with a mask in motion. The method attains accuracy up to 95.77% and 94.58% respectively on two different datasets. We explore optimized values of parameters using the Sequential Convolutional Neural Network model to detect the presence of masks correctly without causing over-fitting. Effective strategies to restrain COVID-19 pandemic need high attention to mitigate negatively impacted communal health and global economy, with the brim-full horizon yet to unfold. In the absence of effective antiviral and limited medical resources, many measures are recommended by WHO to control the infection rate and avoid exhausting the limited medical resources. Wearing a mask is among the non-pharmaceutical intervention measures that can be used to cut the primary source of SARS-CoV2 droplets expelled by an infected individual. Regardless of discourse on medical resources and diversities in masks, all countries are mandating coverings over the nose and mouth in public. We will use the dataset to build a COVID-19 face mask detector with computer vision using Python, OpenCV, and TensorFlow and Keras. In our proposed system we will use a live video stream and finally in the output it gives a red box on the face when someone is not wearing a mask. Our goal is to identify whether the person on the image/video stream is wearing a face mask or not with the help of computer vision and deep learning.

Index Terms - Mask, Recognition, CNN, Mobile Net V2

I. INTRODUCTION

Face mask detection refers to detecting whether a person is wearing a mask or not. In fact, the problem is reverse engineering of face detection where the face is detected using different machine learning algorithms for the purpose of security, authentication and surveillance. Face detection is a key area in the field of Computer Vision and Pattern Recognition. A significant body of research has contributed sophisticated algorithms for face detection in the past. The primary research on face detection was done in 2001 using the design of handcraft features and application of traditional machine learning algorithms to train effective classifiers for detection and recognition. The problems encountered with this approach include high complexity in feature design and low detection accuracy. In recent years, face detection methods based on deep convolutional neural networks (CNN) have been widely developed to improve detection performance.

With an extensive dataset containing 45,000 images, our technique achieves outstanding accuracy of 98.2%. The major contribution of the proposed work is given below:

1. Develop a novel object detection method that combines one-stage and two-stage detectors for accurately detecting the object in real-time from video streams with transfer learning at the back end.
2. Improved affine transformation is developed to crop the facial areas from uncontrolled real-time images having differences in face size, orientation and background. This step helps in better localizing the person who is violating the facemask norms in public areas/ offices.
3. Creation of unbiased facemask dataset with imbalance ratio equals nearly one.
4. The proposed model requires less memory, making it easily deployable for embedded devices used for surveillance purposes.

If deployed correctly, the COVID-19 mask detector we're building here today could potentially be used to help ensure your safety and the safety of others (but I'll leave that to the medical professionals to decide on, implement, and distribute in the wild).

II. LITERATURE SURVEY

A. Literature Survey of the Existing System

1. A Multi-stage CNN architecture for face mask detection

This system made here can be embedded and pre-installed with CCTV cameras.The architecture is based on dual-stage (CNN) architecture which have the ability of detecting masked and unmasked faces. It will help to track safety violations, promote the use of face masks and ensure a safe working environment, to prevent civilians from COVID-19 virus transmission.Some data were scrapped from the internet to build non masked faces and some of the data was collected from public places. Both masked and unmasked datasets are used. They use only pretrained datasets for detection. We can use any cameras to detect faces.It will be very useful for society and for peoples to prevent them from virus transmission. Live video detection was used to detect using open cv(python library).

2. Real time face mask recognition with alarm system using deep learning.

The methodology used in this project gives us accurate and speedy results for detection of facemasks. Hardware components like Raspberry pi are used which are based on real time face mask recognition that detects the facial image. VGG-16 architectural features are used in this system as the foundation network for face recognition. Deep learning techniques are applied to construct a classifier that will collect images of a person wearing a face mask and no masks. The system captures an image of the user's face and analyzes and generates results for each frame and accurately gives the result whether wearing a mask or not. The proposed study makes use of the architectural features of CNN for face detection as a foundation network. It shows accuracy in detecting a person wearing a face mask and not wearing a face mask .This study presents a useful tool in fighting the spread of covid 19 virus.

3. Face detection techniques: a review

Human beings do not have tremendous ability to identify and recognize different faces compared to machines, so machines like automatic face detection systems play a vital role in face recognition, head pose and different face gestures estimation etc. The systems may not be able to handle problems like face occlusion ,and non uniform illumination. To detect faces in Live Stream Neural Network is used. Tensor flow is also used in this system . In this system they have used Adaboost algorithm, we are using mobile NetV2, CNN Architecture model in our proposed system. By this we can overcome all these problems.

4. Face Mask Detector

These systems can be deployed in public places like shopping malls, railway systems,airports, heavy traffic road ways and also as attendance systems in companies and educational institutions. Single Shot Detector architecture is used for the face detection purpose. The system can be used to monitor the public and to avoid the spread of the disease by checking who is following basic rules and who is not. It takes a large amount of time for data loading in Google Colab Notebook. Also webcam access is restricted which was a barrier in

testing images and video streams. In our system we have modeled our facemask detector using Deep learning. We processed a system computationally well structured,optimised and efficiently using MobileNetV2 which makes it easier to Extract the data sets. CNN architecture can fix any kind of camera and it is used in our system.

5. Covid-19 Facemask Detection with Deep Learning and Computer Vision

In this system they have used deep learning,CNN which provides fast and high accuracy. Manual Monitoring is also possible. This system can be deployed and scaled easily at any public place. They have used different architecture models that can overcome the facial detection challenges. We have used different python libraries to get accurate results and also an alarming buzzer notification if any anomaly is found.

B. *Methodologies used*

System design

This project is implemented using python programming language along with Deep learning ,Neural Network, Machine learning , Computer vision and also with python libraries. The architecture consists of Mobile Net as the backbone, it can be used for high and low computation scenarios.
Computer Vision is used for face detection. Model is trained using python libraries like keras, tensorflow. Then serializing the dataset to face mask detectors. We are using CNN Algorithm in our proposed system.

III. IMPLEMENTATION

The work is divided into 4 phases:

1. Collection of Datasets

We collect no data sets with a face mask and without masks. We can get high accuracy by collecting the number of images. The dataset contains around 1800 images. To adapt and detect different positions and orientations of face and mask the dataset is generated by rotating and creating different angles. This would train the model accurately.

2. Extraction of Data

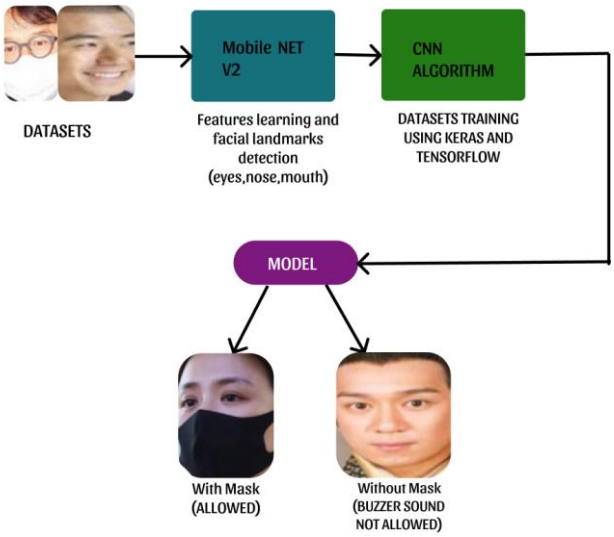
We can extract the features using mobile net v2 of mask and no mask sets. Also facial landmarks detection i.e. Region of Interest (ROI).

3. Training of Models

We will train the model using open cv,keras (python library).

4. Facemask Detection

We can detect Pre-processing images and also detect via live video . If people wear masks, it will permit them,if not then it will give the buzzer to wear masks to prevent them from virus transmission.



IV. PROPOSED SYSTEM

A. Proposed System and Algorithm

We can tackle and predict new diseases by the help of new Technologies such as artificial intelligence, Iot, Big data, and Machine learning. In order to better understand infection rates might be decreased through our technique. People are forced by laws to wear face 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 in public areas. So we will create an automation process for detecting the faces. Here we introduce a facemask detection model that is based on computer vision and deep learning. The proposed model can be integrated with Surveillance Cameras to impede the COVID-19 transmission by allowing the detection of people who are wearing masks not wearing face masks. The model is integration between deep learning and classical machine learning techniques with Opencv, Tensor flow and Keras. We will achieve the highest accuracy and consume the least time in the process of training and detection.

a. Architecture/ Framework

Single Shot Detector architecture is used for the object detection purpose. In this system face mask detectors can be deployed in many areas like shopping malls, airports and other heavy traffic places to monitor the public and to avoid the spread of the disease by checking who is following basic rules and who is not.It takes excessive time for data loading in Google Colab Notebook. It did not allow the access of a webcam which posed a hurdle in testing images and video stream.We have modeled a facemask detector using Deep learning. We process a system computationally efficiently using MobileNetV2 which makes it easier to Extract the data sets. We use CNN architecture for better performance.We can fix it in any kind of camera.

b. Algorithm and Process Design

The major requirement for implementing this project is using python programming language along with Deep learning ,Machine learning , Computer vision and also with python libraries. The architecture consists of Mobile Net as the backbone, it can be used for high and low computation scenarios.We are using CNN Algorithm in our proposed system.

We have four modules:

1. *Datasets Collecting:* We collect no data sets with a face mask and without masks. We can get high accuracy by collecting the number of images .
2. *Datasets Extracting:* We can extract the features using mobile net v2 of mask and no mask sets
3. *Models Training:* We will train the model using open cv,keras (python library).
4. *Facemask Detection:* We can detect Pre-processing images and also detect via live video . If people

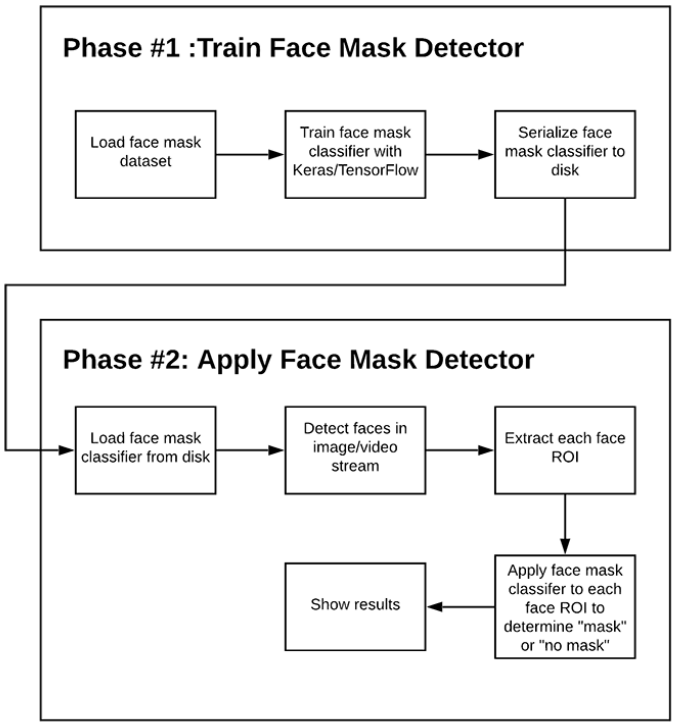
wear masks, it will permit them,if not then it will give the buzzer to wear masks to prevent them from virus transmission.

c. Experiment and Results for Validation and Verification

The images of the proposed dataset were collected from multiple public datasets, as well as images from the Internet. We named it the Properly Wearing Masked Face Detection Dataset (PWMFD). This built dataset contained 2951 images from WIDER Face [34], 2581 images from MAFA [35], 58 images from RMFD [39], and 3615 images obtained via the Internet. Because the annotation format of each dataset was different and some data did not meet our requirements, we re annotated all the data. To prevent the models from being deceived by people who covered their faces with other objects, we annotated the samples in such cases with the label "without_mask". To train and test the model, we split the dataset into two parts. The training set contained 7385 images, and the testing set contained 1820 images. Among them, there were 7695 properly masked faces, 10,471 unmasked faces, and 366 incorrectly masked faces.

d. Analysis

To evaluate the effectiveness and practicality of the proposed method, in this part, we present an access control gate system prototype equipped with SE-YOLOv3, which can be deployed at public places' entrances. The structure of the access control gate system prototype, including a camera, an infrared thermography device, a Raspberry Pi, a screen, a retractable arm, an Arduino, and an access gate. The Raspberry Pi was connected to multiple components and served as a terminal for capturing video frames and thermal imaging data, which were later sent to a server for model inference. We deployed SE- YOLOv3 on a GPU server, which was in the same local area network as the Raspberry Pi. After obtaining the inference information from the server, the Raspberry Pi displayed the result on the screen and sent hardware control commands to the Arduino to operate the access gate and camera. The Arduino is a project consisting of a physical programmable circuit board and an Integrated Development Environment (IDE). The circuit was connected to a motor to control the hardware. Furthermore, the camera was designed to be rotatable.



B. *Advantages*

1. Manual Monitoring is very difficult for officers to check whether the people are wearing masks or not. So in our technique, We are using a webcam to detect peoples faces and to prevent virus transmission.
2. It has fast and high accuracy
3. This system can be implemented in ATMs, Banks etc
4. We can keep people safe from our technique.
5. It provides a buzzer sound to wear a mask.

IV. CONCLUSION

Due to the urgency of controlling COVID-19, the application value and importance of real-time mask detection are increasing. To address this issue, we built the PWMFD with 9205 quality masked face images and developed SE-YOLOv3, a fast and accurate mask detector with a channel attention mechanism that enhanced the feature extraction capability of the backbone network. Furthermore, we used GIoU and focal loss and adopted the corresponding data augmentation to improve the accuracy and robustness of the model. In our future work, we will collect more data and make a balance between different categories of the data to improve the PWMFD. Besides, we will take parameters and flops into consideration and deploy SE-YOLOv3 on lightweight devices, which can further contribute to global health. In this work, a deep learning-based approach for detecting masks over faces in public places to curtail the community spread of Coronavirus is presented. The proposed technique efficiently handles occlusions in dense situations by making use of an ensemble of single and two-stage detectors at the pre-processing level. The ensemble approach not only helps in achieving high accuracy but also improves detection speed considerably. Furthermore, the application of transfer learning on pre-trained models with extensive experimentation over an unbiased dataset resulted in a highly robust and low-cost system. The identity detection of faces, violating the mask norms further, increases the utility of the system for public benefits.

Finally, the work opens interesting future directions for researchers. Firstly, the proposed technique can be integrated into any high-resolution video surveillance devices and not limited to mask detection only. Secondly, the model can be extended to detect facial landmarks with a facemask for biometric purposes.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.The accuracy of the model will be achieved and the optimization of the model is a continuous process and So we are building a highly accurate solution. We can prevent peoples from Virus Transmission through this System.

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