Face-Mask Detection

Aditya Parikh

Under Guidance of Prof. Vijay Mane

***Abstract* — In this project we will be using image processing approach to detect the presence of face-mask. As face-mask are compulsion in today's world, this system can be set-up at schools, colleges, malls ,etc. to ensure that person entering the arena is equipped with mask and also wearing it properly. Also an alarming system is developed so that if system detects and person with the mask, it alerts the authority about the same.**

Keywords *— MATLAB, Face, Mask, Nose, KLT, Voila-Jones*

I. Introduction

The trend of wearing face 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 COVID-19 transmission. COVID19 (known as corona virus) is the latest epidemic virus that hit the human health in the last century. In 2020, the rapid spreading of COVID-19 has forced the World Health Organization to declare COVID- 19 as a global pandemic.

Here we introduce a mask face detection model that is based on computer vision and image processing. 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 MATLAB. We have used deep transfer leering for feature extractions.

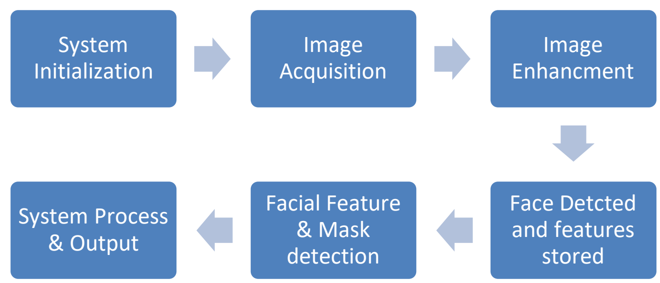
II. Literature Review

Face-mask detection is fairly new idea arises due to widespread of COVID-19. Also there are many research paper published on face detection technology which are quite effective and produced almost perfect results.
Face-mask detection system using Deep-Learning and Computer-vision gives effective results but is time consuming and have complex procedure. Also we cannot further develop this and implement this as hardware module.

We have referred IRJET papers for keep our self updated about the development already made.

III. Methodology/Experimental

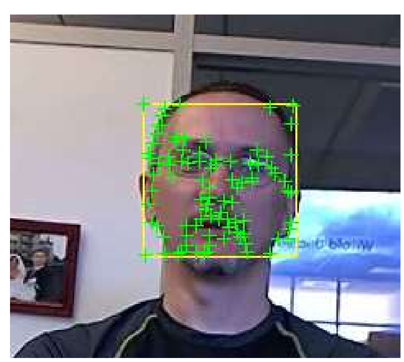
A. Flowchart

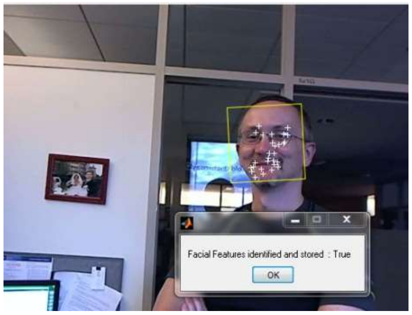


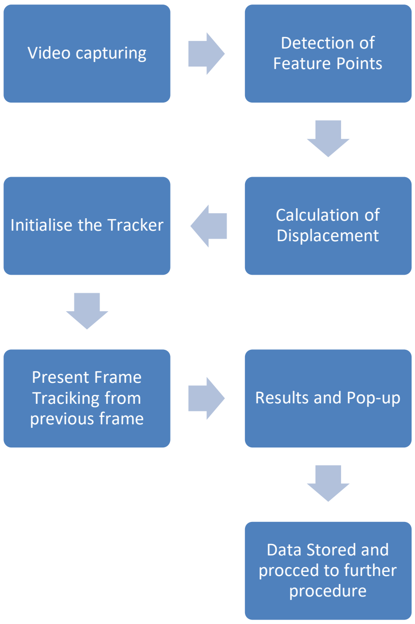
B. Algorithm

B1. Kanade-Lucas-Tomasi

KLT algorithm here is used for tracking human face in a continuous video frame. This method is accomplished by them finding the parameters that allow the reduction in are related to original translational model .



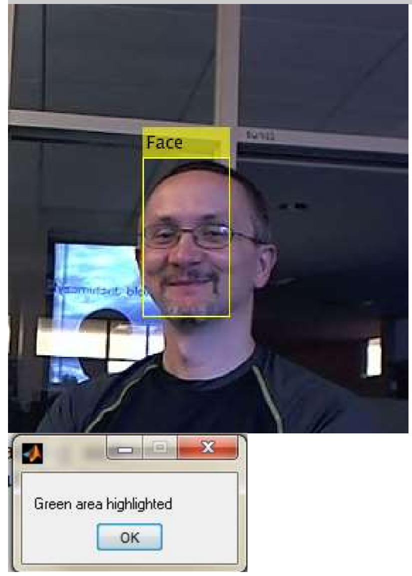




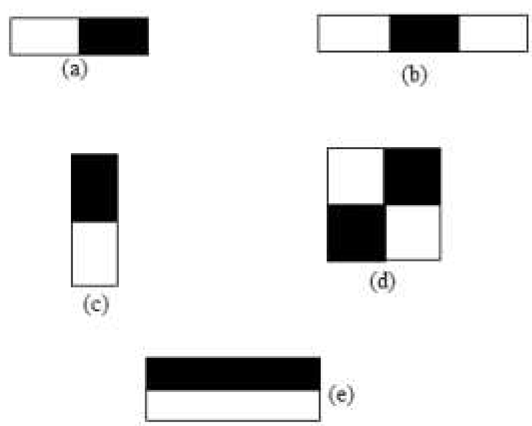
Firstly in this algorithm we calculate the displacement of the tracked points from one frame to another frame. KLT tracking algorithm tracks the face in two simple steps, firstly it finds the traceable feature points in the first frame and then tracks the detected features in the succeeding frames by using the calculated displacement. This process will detect the traceable human face and store the data as 'BBox' for further processes.
The advantage using this before CamShift process for detecting facial feature is that, KLT algorithm can trace tilted face unlike any other process. The displacement between trace points will be same irrespective of tilt and distance from camera.

B2. Detection of facial features using CamShift

The cascade object detector uses the Viola-Jones detection algorithm and a trained classification model for detection. By default, the detector is configured to detect faces, but it can be configured for other object types.
Area around nose and mouth which are supposed to be covered by face-mask are labelled as Green and Red area respectively.
If either of any area is detected by system, this will alert the user about the same. This procedure will be carried using loops.



It basically detects the features using trained models. The used algorithm helps us detect features of a face in a particular frame of a video sequence. This is the first object detection framework which gives a competition to real time detection rate. Firstly, we train the system with the haar features. Haar features are a kind of rectangular boxes which are black and white.



These haar features are applied to determine the facial features. For example in the Figure above, this part is used to detect nose feature of a human face as the black colored part defines the presence of a nose which is located at the center of the face. And the Figure (e) is

called a 4 rectangle feature. Where the black part is denoted as +1 and the white part is denoted as -1.
This process will then detect the nose area and mouth (mentioned as green area and red area respectively) as stored the data.
Detection of either of this area will considered as object is not wearing a mask.

C. CLASSIFIERS AND FEATURE EXTRACTION

C1. Adaaboost

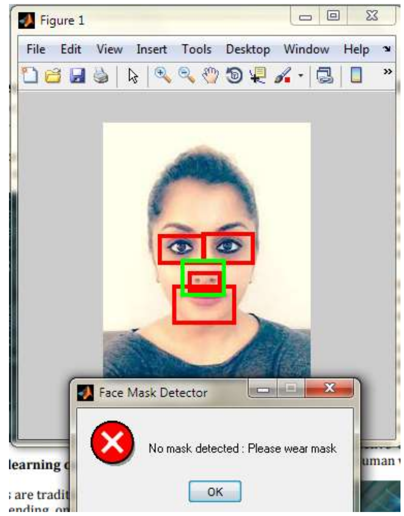
It is a process used to find out relevant and irrelevant features. It uses the weak classifiers and weights to form a strong classifier. It finds the single rectangular feature and threshold which is the best to separate the faces and non-faces in training examples in terms of weighted errors.

C2. Cascading

This step is introduced to speed up the process and give an accurate result. This step consists of several stages where each stage consists of a strong classifier. All features are grouped into several stages. It detects faces in the frame by sliding a window over a frame.

IV. Results and Discussions

Results will then be displayed using pop-ups and JAVA-scripted voice alerts will also be generated.
Threshold value while detecting nose and mouth will be adjusted according to quality of image acquired.
If a face detected also detects the nose and mouth which will then be classified as, an image without mask. Similarly for detecting person wearing mask,
Also a special case where mask is wore but the nose is not covered will generate results in which a person will not be able to enter an arena.
Project accuracy was found to be 100% when trained with sampled images.
And execution time was found to be 369ms and maximum of 699ms.



V. Comparison with Available Technologies

1. A face-mask detector using Semantic Segmentation was proposed, which effectively detected face-mask also multiple face-mask but lacked in accuracy measures. It is designed in such a way that, to directly detect a face-mask from a object's face. But this approach has a major flaw, a variety of masks are available in market, some of them are even indistinguishable from human face colour. Training that model with such diversity and updating regularly is also a major concern.

2. Mask detection using Voila-Jones algorithm. This method detects facial feature (nose and mouth) at a first step. This approach lacked flexibility. A person far away or too close or tilted with respect to to camera was discarded by the system.

Using KLT algorithm and then using CamShift on the same frame gives this technology a wider dimension, where a tilted target face can also be recognised and will provide better results than mentioned.
Also pop-up notification feature and voice alert feature will help this project reach different sectors such as manufacturing units, chemical laboratories ,and more where wearing a mask is compulsory.

VI. Limitations

Detection the facial feature was biggest challenge faced as no person has exact similar features. There are people with beard/cap/other accessories around their face.
This project now has the capability to neglect such but have few accuracy issues for the same.
Also no hardware implementation of this is designed.

VII. Future Scope

Increasing the accuracy and reducing the excecution time will be the issues to be worked on if implemented as hardware system.
Also designing an application to monitor the data extracted.

VIII. CONCLUSION

This project can successfully detect a human face even if faces are titled/moving. Also the facial features are also identified with accuracy of 100%.
Person with or without mask can be identified by the system and alert them for the same.

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