

A SURVEY ON FACE MASK DETECTION IN PUBLIC PLACES

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Abstract - Changes in the lifestyle of everyone around the world. In those changes wearing a mask has been very vital to every individual. Detection of people who are not wearing masks is a challenge due to Outbreak of the Coronavirus pandemic has created various the large number of populations. The COVID-19 pandemic has reshaped life. Many of us are staying home, avoiding people on the street and changing daily habits, like going to school or work, in ways we never imagined. While we are changing old behaviors, there are new routines we need to adopt. First and foremost is the habit of wearing a mask or face covering whenever we are in a public space. Masks and face coverings can prevent the wearer from transmitting the COVID-19 virus to others and may provide some protection to the wearer. Universal mask use can significantly reduce virus transmission in the community by preventing anyone, including those who are unwittingly carrying the virus, from transmitting it to others. Thus, the relevance of wearing mask and its detection is very clear. Face mask detection systems are now increasingly important, especially in smart hospitals for effective patient care. They're also important in stadiums, airports, warehouses, and other crowded spaces where foot traffic is heavy and safety regulations are critical to safeguarding everyone's health. Face mask detection system can ensure our safety and the safety of others. This project can be used in schools, hospitals, banks, airports, and etc. as a digitized scanning tool. The technique of detecting people's faces and segregating them into two classes namely the people with masks and people without masks is done with the help of image processing and deep learning. With the help of this project, a person who is intended to monitor the people can be seated in a remote area and still can monitor efficiently and give instructions accordingly. Various libraries of python such as Open CV, Tensor flow and Keras are used. In Deep Learning Convolution Neural Networks is a class Deep Neural Networks which is used to train the models in this project.

Key Words: Deep Learning, Computer Vision, OpenCV, TensorFlow, Keras.

1. INTRODUCTION

The trend of sporting face mask publicly is rising because of the Covid-19 epidemic everywhere in the world. Because people won't wear mask to shield their health from air pollution. COVID-19 spreads mainly from person to person through respiratory droplets. Respiratory droplets travel into the air when we cough, sneeze, talk, shout, or sing. These droplets can then land in the mouths or noses of people who are near you or they may breathe these droplets

in masks are a simple barrier to help prevent our respiratory droplets from reaching others. Studies show that masks reduce the spray of droplets when worn over the nose and mouth. We should wear a mask, even if we do not feel sick. This is because several studies have found that people with COVID-19 who never develop symptoms (asymptomatic) and those who are not yet showing symptoms (pre-symptomatic) can still spread the virus to other people. Wearing a mask helps protect those around us, in case we are infected but not showing symptoms. It is especially important to wear a mask when we are indoors with people we do not live with and when we are unable to stay at least 6 feet apart since COVID-19 spreads mainly among people who are in close contact with one another.

Analyzing the current scenario, government and private organizations want to make sure that everyone working or visiting a public or private place is wearing masks throughout the day. The face mask detection platform can quickly identify the person with a mask, using cameras and analytics. The face mask recognition system uses AI technology to detect the person with or without a mask. It can be connected with any surveillance system installed at your premise. The authorities or admin can check the person through the system to confirm their identity. The system sends an alert message to the authorized person if someone has entered the premise without a face mask. The accuracy rate of detecting a person with a face mask is 95-97% depending on the digital capabilities. The data has been transferred and stored automatically in the system to enable reports whenever we want. The system is easy to implement in any existing organizational system. Custom alerts can be sent to the person with or without a face mask or the one whose face is unrecognizable in the admin system. No need to install any hardware as the system can be connected with your existing surveillance system only. The system can be used easily with any camera or hardware like surveillance cameras. The system restricts access for those not wearing the masks and notifies the authorities. Also, can customize the face mask detection system based on our business requirements. We can check the analytics based on the system generated reports. Easy to access and control the movements from any device through face mask detection applications. Detecting masked faces is challenging because the system cannot detect incomplete or inaccurate facial features. But thanks to advanced technology and continuous research and studies performed by so many tech-leaders. Moreover, artificial intelligence (AI) and machine learning (ML) communities are developing various models withstanding the urgent need for detecting masked faces.

Detecting masked faces requires making a system that can identify the available data-sets of a masked face, i.e., facial features. The advanced detection technology includes various attributes as mentioned here like Location of Faces, annotated by a shape i.e., square Face Orientation, includes front, left, left-front, right, right-front. Location of Eyes, need to mark eye centers. Location of Masks, annotated by a shape i.e., rectangles. Type of Masks, i.e., human-made masks with or without logo, face covered by hand, etc. Occlusion Degree, defining a face into four regions – eyes, nose, chin, and mouth the monitoring process involves the finding of anyone who is not wearing a face mask. Here we introduce a face mask detection system that support machine learning and image processing techniques. The planned model may be detecting the mask with image and real time detection people wearing mask or not wearing a mask. The model is integration between deep learning and classical machine learning techniques with Open CV, Tensor Flow and Keras.

1.1 RELATED WROKS

Generally, most of the projects specialize in face construction identity recognition when wearing mask. During this project, the focus is on recognizing the people that wearing mask, or not help in decreasing the transmission and spreading of covid-19. The scientist has proven that wearing a mask help in minimizing the spreading rate of Covid-19. R. Ranjan, V. M. Patel, and R. Chellappa proposed "Hyperface: A deep multitask learning framework for face detection, landmark localization, pose estimation, and gender recognition," [1] in which present an algorithm for simultaneous face detection, landmarks localization, pose estimation and gender recognition using deep convolutional neural networks (DCNN). The main disadvantage of this system is its computational burden. A. Kumar, R. Ranjan, V. M. Patel, and R. Chellappa proposed "Face alignment by local deep descriptor regression," [2] in which this paper discuss about different modules involved in designing an automatic face recognition system. Feature matching via local descriptors is one of the most fundamental problems in many computer visions tasks, as well as in the remote sensing image processing community. For example, in terms of remote sensing image registration based on the feature, feature matching is a vital process to determine the quality of transform model. While in the process of feature matching, the quality of feature descriptor determines the matching result directly. At present, the most commonly used descriptor is hand-crafted by the designer's expertise or intuition. However, it is hard to cover all the different cases, especially for remote sensing images with nonlinear grayscale deformation. One of the disadvantages is that it still faces many challenges, like pose variation, illumination variation etc.

A. Bansal, R. Ranjan, C. D. Castillo, and R. Chellappa proposed "Deep features for recognizing disguised faces in the wild," [3] in which this paper presents an approach for general face verification and evaluated it on the Disguised Faces in the Wild challenge. This is an extremely challenging face

verification problem. The aim of a face verification system in such cases is to be able to identify disguises and reject impersonators. Building such a system will be extremely helpful in law enforcement applications. One of the problems is performance only under controlled scenarios. D. Yi, Z. Lei, S. Liao, and S. Z. Li proposed "Learning face representation from scratch" [4], Pushing by big data and deep convolutional neural network (CNN), the performance of face recognition is becoming comparable to human. Using private large scale training datasets, several groups achieve very high performance on LFW, i.e., 97 to 99%. While there are many opensource implementations of CNN, none of large-scale face dataset is publicly available. The current situation in the field of face recognition is that data is more important than algorithm. This paper proposes a semi-automatic way to collect face images from Internet and builds a large-scale dataset containing about 10,000 subjects and 500,000 images, called CASIA Web Face. S. Yang, Y. Xiong, C. C. Loy, and X. Tang. Proposed "Face detection through scale-friendly deep convolutional networks," [5] This paper presents framework to detect faces with very large-scale variance. A deep CNN model is built for the pedestrian detection, which consists of 10 convolutional layers, 4 max pooling layers, and 1 fully connected layer for classification. Do not encode the position and orientation of object is one of its drawbacks. Facial recognition system is a biometric technology used for mapping the facial features, patterns, and/or texture of an individual from a digital image or live video feed for the purpose of identity storage and verification. The system specifically uses a combination of mathematical analysis and artificial intelligence, particularly machine learning algorithms, for the collection, storage, and retrieval of biometric data, as well as other sensing imaging techniques to include photometry and LiDAR or light detection and ranging, among others.

Rajeev Ranjan, Ankan Bansal, Jingxiao Zheng, Hongyu Xu, Joshua Gleason, Boyu Lu, Anirudh Nanduri, Jun-Cheng Chen, Carlos D. Castillo, and Rama Chellappa, proposed "A Fast and Accurate System for Face Detection, Identification, and Verification" [6]. In this paper, describe a deep learning pipeline for unconstrained face identification and verification which achieves state-of-the-art performance on several benchmark datasets. Here provide the design details of the various modules involved in automatic face recognition: face detection, landmark localization and alignment, and face identification/verification. Also propose a novel face detector, deep pyramid single shot face detector (DPSSD), which is fast and detects faces with large scale variations (especially tiny faces). Additionally, here propose a new loss function, called crystal loss, for the tasks of face verification and identification. Crystal loss restricts the feature descriptors to lie on a hypersphere of a fixed radius, thus minimizing the angular distance between positive subject pairs and maximizing the angular distance between negative subject pairs. Also provide evaluation results of the

proposed face detector on challenging unconstrained face detection datasets.

Yongqiang Li; Shangfei Wang; Yongping Zhao; Qiang Ji proposed "Simultaneous Facial Feature Tracking and Facial Expression Recognition" [7] The tracking and recognition of facial activities from images or videos have attracted great attention in computer vision field. Facial activities are characterized by three levels. First, in the bottom level, facial feature points around each facial component, i.e., eyebrow, mouth, etc., capture the detailed face shape information. Second, in the middle level, facial action units, defined in the facial action coding system, represent the contraction of a specific set of facial muscles, i.e., lid tightener, eyebrow raiser, etc. Finally, in the top level, six prototypical facial expressions represent the global facial muscle movement and are commonly used to describe the human emotion states. In contrast to the mainstream approaches, which usually only focus on one or two levels of facial activities, and track (or recognize) them separately, this paper introduces a unified probabilistic framework based on the dynamic Bayesian network to simultaneously and coherently represent the facial evolution in different levels, their interactions and their observations. Advanced machine learning methods are introduced to learn the model based on both training data and subjective prior knowledge. Given the model and the measurements of facial motions, all three levels of facial activities are simultaneously recognized through a probabilistic inference. Extensive experiments are performed to illustrate the feasibility and effectiveness of the proposed model on all three level facial activities. B. QIN and D. Li, proposed "Identifying facemask-wearing condition using image super-resolution with classification network to prevent COVID-19" [8], the authors developed a face mask wearing condition identification method. They were ready to classify three categories of face mask-wearing. The categories are face mask-wearing, incorrect face mask-wearing and no face mask-wearing. C. Li, R. Wang, J. Li, L. Fei proposed "Face detection based on YOLOv3, in Recent Trends in Intelligent Computing, Communication and Devices" [9], the authors used the YOLOv3 algorithm for face detection. YOLOv3 uses Darknet-53 because the backbone. Prior detection systems repurpose classifiers or localizers to perform detection. They apply the model to an image at multiple locations and scales. High scoring regions of the image are considered detections. Here uses a totally different approach. Here applies a single neural network to the full image. This network divides the image into regions and predicts bounding boxes and probabilities for each region. These bounding boxes are weighted by the predicted probabilities.

Sheshang Degadwala, Sagar Pandya, Vidisha Patel, Shraddha Shah, Udita Doshi proposed "A review on real time face tracking and identification for surveillance system" [10] The demand of smart cameras for various applications in surveillance for security purpose is growing rapidly.

However, till now, the processing required for real time face detection prohibits integration of the complete application into a small sized camera. The Real Time Face Tracking and Identification for Surveillance System proposed in this research work has come up with a simple and an efficient approach to satisfy the processing requirements and enable fast and accurate face detection. The core functionality of Real Time Face Tracking and Identification for Surveillance System is to allow tracking and recognition of human faces in a video stream and thereby provide a centralized, cost effective and robust mechanism of securing business and government premises. The primary objective of the proposed system is to reduce detection redundancy, minimize misclassification risk, provide huge processing capacity and work within a reasonable computational budget. P. Drozdowski; C. Rathgeb; C. Busch proposed "Turning a Vulnerability into an Asset: Accelerating Facial Identification with Morphing" [11], In recent years, morphing of facial images has arisen as an important attack vector on biometric systems. Detection of morphed images has proven challenging for automated systems and human experts alike. Likewise, in recent years, the importance of efficient (fast) biometric identification has been emphasized by the rapid rise and growth of large-scale bio-metric systems around the world. IN this paper, the aforementioned, hitherto unrelated, topics within the biometrics domain are combined: the properties of morphed images are exploited for the purpose of improving the transaction times of a biometric identification system. Specifically, morphs of two or more samples are used in the pre-selection step of a two-stage biometric identification system. In a proof-of-concept experimental evaluation using two state-of-the-art open-source facial recognition frameworks it is shown, that the proposed system achieves hit rates comparable to that of an exhaustive search-based baseline, while significantly reducing the penetration rate (and thus the computational workload) associated with the biometric identification transactions.

2. FACE DETECTION

The downside of face mask detection is all regarding face detection. However, before face mask detection is possible, one should be able to faithfully notice a face and its landmarks. This can be basically a segmentation problem and in sensible system, most of the trouble goes into finding this task. After all the particular detection supported option extracted from these facial landmarks is barely a minor step.

This system focuses on how to identify a person wearing a mask on the image/video stream with the help of computer vision and deep learning algorithm by using OpenCV, tensor flow and Keras library.

Method: 1. Train deep learning model (MobileNetV2). 2. Apply face mask detector over images/live video stream.

Step 1. Data Visualization: In this first step, let us visualize the total number of images in the dataset in these two categories. We can see that there are 800 images in the “yes” category and 750 images in the “no” category.

Step 2. Data Augmentation: In the next step, here expand the data set to include a larger number of images for training. In this step of data expansion, we rotate and flip each image in the dataset. Here see that after data expansion, we have total 2851 images of which the “yes” category contains 1430 image, and the “no” category contains 1421 images.

Step 3. Splitting the Data: In this step, we divide the data into training set, and the training set will contain the image on which the CNN model will be trained and test set and the images on which the model will be tested. In this case, Here use split size=0.8, which means that 80% of the total images will enter the training set, and the remaining 20% of the images will enter the test set.

Step 4. Building the Model: In the next step, here use Conv2D, MaxPooling2D, Flatten, Dropout, and dense to build a sequential CNN model. In the last dense layer, will use the “SoftMax” function to output vector that gives the probability of each of the two categories. Here, use “ADAM” optimizer and binary cross-entropy as loss function because there are only two types. In addition, can even use MobileNetV2 to get better accuracy.

Step 5. Pre-Training the CNN Model: After setting up the model, let us create “train generator” and “validation generator” to make it fit model in the next step.

Step 6. Training the CNN Model: This is the main step in which put images into training set a test set to use the sequence model built by the Keras library.

Step 7. Labeling the Information: After building the model, label the result with two probabilities. [“0” is without mask”, “1” is “with mask”]. Also, can set the color of the bounding rectangle using RGB values. [“ RED” stands for” without mask”” GREEN” stand for” with mask”].

Step 8. Importing the face detection program: From now on, plan to use it detect whether we are wearing a mask through the pc’s webcam. For this, first of all, need to implement face detection model.

Step 9. Detecting the Faces with and without Mask: In the last step, use the Open CV library to run an infinite loop to use our webcam, where the cascade classifier is used to detect faces. The model will predict the likelihood of each of the two categories (without mask, with mask)]. Based on a higher selected and displayed around face.

MobileNetV2: MobileNetV2 is that the latest technology of mobile visual recognition, including classification, object detection and semantic segmentation. The classifier uses deep intelligent separable convolution, its purpose is to significantly reduce the complexity cost and model size of the network, so it’s suitable for mobile devices, or devices with low computing power. In MobileNetV2, another best module introduced is that the reverse residual structure. The non-linearity within the narrow layer is removed. Maintain because the backbone of feature extraction, MobileNetV2 achieves the simplest performance in object detection and semantic segmentation. MobileNetV2 is predicated on thought of mobileV1, using deeply intelligent separable convolution as an efficient building piece. However, V2 introduced two new features building.

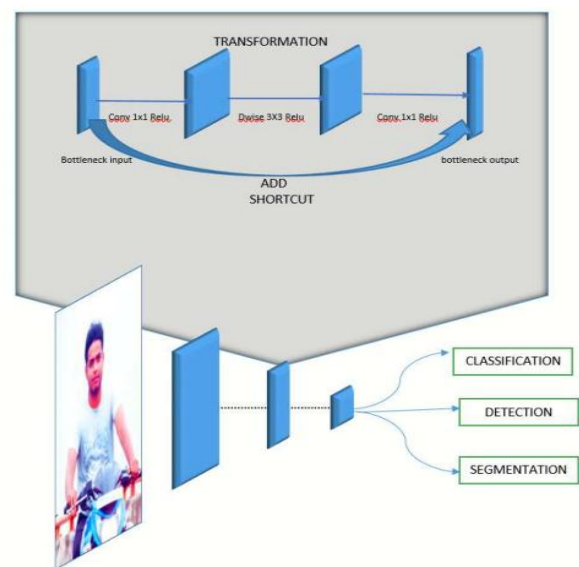


Fig -1: MobileNetv2 Building Block

APPLICATIONS: With the ongoing pandemic, it’s even more important to have advanced analytics apps and services in place to mitigate risk. For public safety and health, authorities are recommending the use of face masks and coverings to control the spread of COVID19. The world is fighting with Covid19 pandemic. There are so many essential equipment’s needed to fight against Corona virus. One of such most essential is Face Mask. Firstly, face mask was not mandatory for everyone but as the day progresses scientist and Doctors have recommended everyone to wear face mask. Now To detect whether a person is wearing Face Mask or not, we will use Face Mask Detection Technique. Face Mask Detection Platform utilizes Artificial Network to perceive if a person does/doesn’t wear a mask. The application can be associated with any current or new IP cameras to identify individuals with/without a mask. Here we will see many important aspects of face mask detection not only for Covid19 cases but also for other regular cases.

1) Airports: The Face Mask Detection System can be utilized at airports to recognize tourists/individual without veils.

2) Hospitals: If any health worker is found without a mask, they will receive a notification with a reminder to wear a mask.

3) Offices: The Face Mask Detection System can be utilized at office area to recognize if employees are keeping up safety standards at work.

4) Educational Institutions: In educational institutes especially where the number of children is more, it is highly recommended to wear face mask for children.

3. CONCLUSIONS

As the technology are blooming with emerging trends the availability so here has novel face mask detector which can possibly contribute to public health care department. The architecture consists of MobileNetV2 classifier and ADAM optimizer as the backbone it can be used for high and low computation scenarios. Our face mask detection is trained on CNN model and we are used Open CV, Tensor Flow, Keras and python to detect whether person is wearing a mask or not. The model was time video stream. The accuracy of model is achieved and, the optimization of the model is continuous process. This specific model could be used as use case of edge analytics.

FUTURE SCOPE

The current ongoing system is gracing with MobileNetV2 classifier one of the best systems which would be implemented along with the interface of alarm and alerting system in future generation. This system will be integrated with the system implementing social distancing that would make it a complete system which can bring a dramatic impact on the spread of. The new world will be wellbeing of high demand of mask as faceless future and that will be a big security concern. Expertise says, CNN that using face mask proves to be the best solution to mitigate the spread of air borne virus like corona, but as a big security concern headed to challenge the nation as it would create a massive opportunity for people who cover their faces for nefarious reason. And also, experts say the mass number of masks wearing it could complicate in crime investigation in the coming days, as facial recognition is an important part in tracking of the criminals. When the pandemic COVID-19 getting over, then this system comes into play for chemical factories, bank, glass factories etc. If a person enters the bank while wearing a mask he would be not allowed to enter and also if the person does not wear masks in glass factories chemical factories and etc. then the person would not be allowed to enter to the industry. A mind concept of human being has been proved out to be very good at recognizing familiar faces and facial recognition algorithms are getting better in identifying pattern. So thus, this challenge would

create a scope to new face mask detection algorithms which can identify faces which are covered with greater accuracy's and precisions.

REFERENCES

- [1] R. Ranjan, V. M. Patel, and R. Chellappa, "HyperFace: A deep multitask learning framework for face detection, landmark localization, pose estimation, and gender recognition," *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 41, no. 1, pp. 121–135, Jan. 2019.
- [2] A. Kumar, R. Ranjan, V. M. Patel, and R. Chellappa, "Face alignment by local deep descriptor regression," *arXiv preprint arXiv:1601.07950*, 2016.
- [3] A. Bansal, R. Ranjan, C. D. Castillo, and R. Chellappa, "Deep features for recognizing disguised faces in the wild," in *Proc. IEEE Conf. Comput. Vis. Pattern Recognit. Workshops*, 2018, pp. 10–16.
- [4] D. Yi, Z. Lei, S. Liao, and S. Z. Li, "Learning face representation from scratch," *arXiv preprint arXiv:1411.7923*, 2014.
- [5] D. Yi, Z. Lei, S. Liao, and S. Z. Li, "Learning face representation from scratch," *arXiv preprint arXiv:1411.7923*, 2014.
- [6] S. Yang, Y. Xiong, C. C. Loy, and X. Tang, "Face detection through scale-friendly deep convolutional networks," *arXiv preprint arXiv:1706.02863*, 2017.
- [7] Rajeev Ranjan, Ankan Bansal, Jingxiao Zheng, Hongyu Xu, Joshua Gleason, Boyu Lu, Anirudh Nanduri, Jun-Cheng Chen, Carlos D. Castillo, and Rama Chellappa, "A Fast and Accurate System for Face Detection, Identification, and Verification," *IEEE Trans. Biometrics, Behaviour, and Identity Science*, VOL. 1, NO. 2, April 2019.
- [8] B. QIN and D. Li, "identifying facemask-wearing condition using image super-resolution with classification network to prevent COVID-19, May 2020, doi: 10.21203/rs.3.rs-28668/v1."
- [9] C. Li, R. Wang, J. Li, L. Fei, "Face detection based on YOLOv3, in: *Recent Trends in Intelligent Computing, Communication and Devices*, Singapore, 2020, pp. 277–284, doi: 10.1007/978-981-13-9406-5-34."
- [10] Sheshang Degadwala; Sagar Pandya; Vidisha Patel; Shraddha Shah; Udit Doshi "A review on real time face tracking and identification for surveillance system" (ICRTEST 2016) ISBN Information:INSPEC Accession Number:17524659 DOI: 10.1049/cp.2016.1477.

[11] P. Drozdowski;C. Rathgeb;C. Busch"Turning a Vulnerability into an Asset: Accelerating Facial Identification with Morphing"ICASSP 2019 - 2019 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP).

[12] P. A. Rota, M. S. Oberste, S. S. Monroe, W. A. Nix, R. Campagnoli, J. P. Icenogle, S. Penaranda, B. Bankamp,K. Maher, M.-h. Chenet al., "Characterization of a novel coronavirus associated with severe acute respiratory syndrome,"science, vol. 300, no. 5624, pp. 1394–1399, 2003.

[13] Z. A. Memish, A. I. Zumla, R. F. Al-Hakeem, A. A. AlRabeeah, and G. M. Stephens, "Family cluster of middle east respiratory syndrome coronavirus infections,"New England Journal of Medicine, vol. 368, no. 26, pp.2487–2494, 2013.

[14] N. H. Leung, D. K. Chu, E. Y. Shiu, K.-H. Chan, J. J. McDevitt, B. J. Hau, H.-L. Yen, Y. Li, D. KM, J. Ipet al., "Respiratory virus shedding in exhaled breath and efficacy of face masks."

[15] S. Feng, C. Shen, N. Xia, W. Song, M. Fan, and B. J. Cowling, "Rational use of face masks in the covid19 pandemic," The Lancet Respiratory Medicine, 2020.

[16] Z. Wang, G. Wang, B. Huang, Z. Xiong, Q. Hong, H. Wu, P. Yi, K. Jiang, N. Wang, Y. Peiet al., "Masked facerecognition dataset and application, arXiv preprint arXiv:2003.09093, 2020.[10] Z.-Q. Zhao, P. Zheng, S.-t. Xu, and X. Wu, "Object detection with deep learning: A review,"IEEE transactions on neural networks and learning systems, vol. 30, no. 11, pp. 3212–3232, 2019.

[17] A. Kumar, A. Kaur, and M. Kumar, "Face detection techniques: a review,"Artificial IntelligenceReview, vol. 52,no. 2, pp. 927–948, 2019.D.-H. Lee, K.-L. Chen, K.-H. Liou, C.-L. Liu, and J.-L. Liu, "Deep learning and control algorithms of direct perception for autonomous driving,2019.