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Face Mask Detection and Social distance monitoring with customized Convolutional Neural Network

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Abstract : The pandemic-scale transmission of COVID-19 has already reached over 200 countries in a short period of time. Real-time applications with help of deep learning models were used in our suggested screening system to identify and classify face masks. Monitoring of social distance was another component we added in application. Using CNN, Yolo and a transfer learning methodology, this system identified people who wear face masks correctly, incorrectly, and without one. We were able to classify and recognise masks with a 99.81 accuracy rate. We strongly believe that local gearboxes might be stopped using our technology.

IndexTerms :COVID-19, CNN, MobilenetV2, face mask detection, deep learning, classification. -

1. INTRODUCTION

The COVID-19 pandemic Disease has caused a serious worldwide health catastrophe that has profoundly affected humanity's perception of the planet and of ourselves. In order to reduce the danger of virus transmission, the WHO currently advises wearing face masks. They also advise maintaining a social distance of at least 6 feet between people in order to prevent the spread of disease from person to person.

Additionally, a lot of public service providers only allow users to access the service if they don masks and observe safe social distance. In order to aid the worldwide community, face mask detection and safe social distance monitoring have therefore become vital computer vision tasks.Automated inspection uses less staff to inspect the general population and is portable, using only a webcam-equipped laptop or PC. As a result, the suggested solution benefits society by reducing the transmission of the Corona virus and saving time.

2 NEED OF THE STUDY

2.1 Use of Image processing in face mask detection and social distancing monitoring

Our effort is focused on learning if the person has worn a mask or not and is following the rule of social separation. Thus, for this purpose, it is important to detect the face of the person, i.e., the object. Thus, object detection is necessary for detecting the face of the person and determining if the person wore a mask or not. Also, the distance between items sensed can be measured, thus tracking social distancing.

2.2 Object Background

According to data obtained by the World Health Organization, the global pandemic of COVID-19 has severely impacted the world and has now infected more than eight million people worldwide. Wearing face masks and following safe social distancing are two of the enhanced safety protocols that need to be followed in public places in order to prevent the spread of the virus. To create a safe environment that contributes to public safety, we propose an efficient computer vision based approach focused on the real-time automated monitoring of people to detect both safe social distancing and face masks in public places by implementing the model and detect violations through camera.

2.3 Proposed System

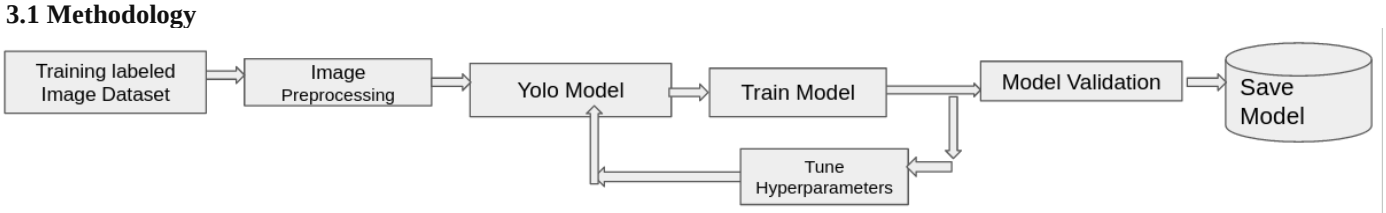
This model will work great on scaling of the data elements in the dataset, also speed for object detection would be faster, thus the model will work more effectively . Predictive analytics combined with machine learning is a powerful way for companies to get value from the massive amounts of data they collect and generate in running their operations. Machine learning is a form of

AI that allows software applications to become progressively more accurate at prediction without being expressly programmed to do so. The machine learns by detecting patterns within the data sets. The algorithms in machine learning programs and software are created to be versatile and allow for developers to make changes via hyperparameter tuning. ML is the foundational basis for deep learning and neural networks, the advanced techniques that are used in applications such as autonomous vehicle operation and financial forecasting.

1 Objectives

1. Developing a novel implementation of real-time based social distancing detection.
2. Detecting Face mask in the same model.
3. Using CNN to get a more fast and accurate result, standard feature points, types of kernel are Gaussian , Gaussian Kernel Radial Basis, Sigmoid Function.

3.1 Methodology



3.1 CNN

A convolutional neural network is a deep learning system that can take in an input image, give various characteristics and objects in the image importance (learnable weights and biases), and be able to distinguish between them. Comparatively speaking, a ConvNet requires substantially less pre-processing than other classification techniques. The entire visual field is covered by a series of such fields that overlap.Our model consists of 4 layers – conventional 2D, max-pooling, flatten and fully connected.

Working : There are 3 elements that enter into Convolution operation : • Input image • Feature detector • Feature map Sometimes a 5×5 or a 7×7 matrix is used as a feature detector, but the more conventional one, and that is the one that we will be working with. The feature detector is often referred to as a "kernel" or a "filter," which you might come across as you dig into other material on the topic. You can think of the feature detector as a window consisting of 9 (3×3) cells.

3.2 Dataset Information

Dataset contains 3833 images out of which 1915 are masked and the rest are unmasked. While deploying the algorithm, model takes a live stream as input.

3.3 Yolo

DarkNet-53 is the name of the architecture that is employed in YOLO v3. For YOLO v3, it is also known as a backbone network. Its main responsibility is to extract features. There are 53 convolutional layers in it. Here, there is no maximum pooling. Convolution is followed by batch normalization and RELU for each convolution process. Because batch normalization wasn't available in early iterations of YOLO and max-pooling was used instead, the results weren't great. Because batch norm makes sure that your inputs are normalized even when you're far into the network, this is the reason. Moreover, stride-2 convolutions are used in these convolutions. Strided-convolutions are employed because max-pooling wasn't performing well and we wanted a way to down-sample our filter maps.See for Size being stated as 3 x 3 /2, here /2 represents stride-2 convolutions. The stride will control the spacing between each sample in an operation on a pixel grid. For example, if stride is two, there will be two pixels between each consecutive sample. If you see in the adjoining graphic, my input is a 5 x 5 matrix, and my output is a 2 x 2 matrix employing 3 x 3 kernels and stride-2 convolutions.

4 Analysis

After detailed study of papers and evaluation based on various parameters are presented in the following tables.

Table 1 Comparative Analysis of Literature

Author	Methodology	Features	Challenges/ Future scope
Shashi Yadav	Uses transfer learning approach optimization with a deep learning algorithm.	Automatically monitoring Social distancing to avoid spread of coronavirus. Implementation was tested successfully in real-time by deploying the model in raspberry pi4	Coughing and sneezing detection Temperature screening

Mingyan Xin,Yong Wang	Image classification using Deep convolutional neural network technique , CNN	Detecting objects from the images given as input using deep CNN	Developing obj ect detection applications.
Arjya Das, Mohommad Wasif Ansari, Rohini Basak	Consist of Cascade classifier and a pre-trained CNN consisting of 2D convolutional layers	Uses 2 datasets Uses max pooling for higher accuracy	Including temperature measurement tool for measuring the body temperature of the person
Moein Razavi, Vahid Janfaza, Benyamin Sadeghi	Trained multiple faster R- CNN object detection models for social distancing monitoring.	Used R- CNN and transfer learning	Detecting Face mask and Temperature sensors
Amrit Kumar Bhadani	Trained deep learning model using mobileNetV2, applying face mask detector over images	Used R- CNN	Implement it along with system monitoring social distancing .
Deepika Jaswal, Soman Kp	Used layers of CNN for Classification purpose	Used CNN	Further modification for classifications of War scene,Stree t/Garden scene,etc.
G.Jignesh Chowdhary, Narinder Singh Punn, Sanjay Ku mar Sonbhadra, Sonali Agarwal	Methodology is split into 2 phases – Oversampling with image augmentation of training data, detection of Face mask using transfer learning of InceptionV3	Deep learning algorithm for Face mask detection	NA
Xinben Jiang, Tianhan Gao, Zichen Zhu, Yukang Zhao	Introduced attention mechanism to the backbone network,then employed GloU and focal loses to accelerate the training process	Uses YOL Ov3	Collect more data and make a balance between different categories of data to improve the PWMFD
Yew Cheo ng Hou, Mohd Zafri Baharuddin, Salman Yussof, Sumayyah Dzulkify	Employed deep CNN method and computer vision techniques,used YOLOv3 for object detection.	Uses CNN along with YOL Ov3	Can be further improvised by improving computing power of the hardware and calibrating camera perspective ,etc
A.Nieto, Rodriguez M. Mucientes, V. M. Brea	The system assigns a per- person ID through tracking in order to trigger only 1 alarm for a maskless person across several frames in a video	Uses NN	Detection of operating room dress code
Ravneet Punia, Lucky Kumar, Mohd.Mujahid, Rajesh Rohilla	Use Residual network with transfer learning	Uses ResNet	Improvisation for first screening at airports, hotels, shopping centers.
Jesus Tomas, Albert Rego, Jaime Lloert	Labeling the data,then facial detection and cropping and finally classification using CNN	Uses CNN with transfer learning	A mobile application can be developed in addition to the model.

4.2 Performance Evaluation of Various Parameters

Here, the lists of the parameters that have been considered in the entire contributions are given in the tabulation for considering it in future works for developing an efficient crop disease classification and identification technique.

Sr. No.	Research Paper's		Performance Measures				
		Type of Data set	Pre processing Technique	Feature Extraction	Classifier	Accuracy	Training Time
1	Deep learning based Social distancing monitoring	Type of input- images No. of images - 3165	Uses existing background subtraction algorithm .	Tensorflow Object detection API	Uses transfer learning approach and MobileNetV2 model.	91.7%	NA
2	Research on image classification model based pn Deep CNN	Type of input- images	Uses PCA algorithm	NA	Uses CNN classifier	83.67%	6.003 seconds
3	Covid 19 Face mask detection using Tensorflow ,keras and OpenCv	Image dataset from kaggle with 1376 images	Uses category image depiction	NA	Uses CNN classifier	94.58%	5.200 seconds
4	An automatic system to monitor physical distance of construction workers in COVID-19 Pandemic	Image dataset from MakeML website	NA	NA	Uses R-CNN	90.20%	NA
5	A Face mask detector using Machine learning and processing techniques	Used image dataset offered within the public domain	Uses PCA algorithm	NA	Uses PCA with R-CNN	90.45%	NA
6	Image classification using CNN	Image input of size 32*32	Gray image	NA	Uses CNN algorithm	92.27%	0.013 seconds
7	Face Mask Detection using Transfer learning of InceptionV3	Uses Simulated Masked Face Dataset	Image augmentation	Transfer learning	Transfer learning of InceptionV3	100%	NA
8	Real-Time Face mask detection model based on YOLOv3	Image dataset from https://github.com/ethancvaa/ Properly-Wearing- Masked-Detect- Dataset	Used PCA	NA	Uses YOLOv3 with Darknet 53	95.3%	0.13 sec
9	Social distancing detectionwith Deep learning g model	Image input from Kaggle dataset	Used PCA	NA	Uses CNN with YOLOv 3	NA	NA

10	Computer Vision and radiology for COVID-19 Detection	Online hosted data from Italian research organization	Uses image depiction	NA	Uses ResNet with transfer learning	NA	NA
11	Mask and Maskless face classification system to detect breach protocols in the operating room	Image input	Uses PCA	NA	Uses NN	NA	NA
12	Incorrect Facemask wearing detection using CNN with transfer learning	Image dataset from synthetic corpus	Used boosted cascade of simple features	NA	Uses CNN with transfer learning	89.37%	NA

5 Result

WelcomePage–

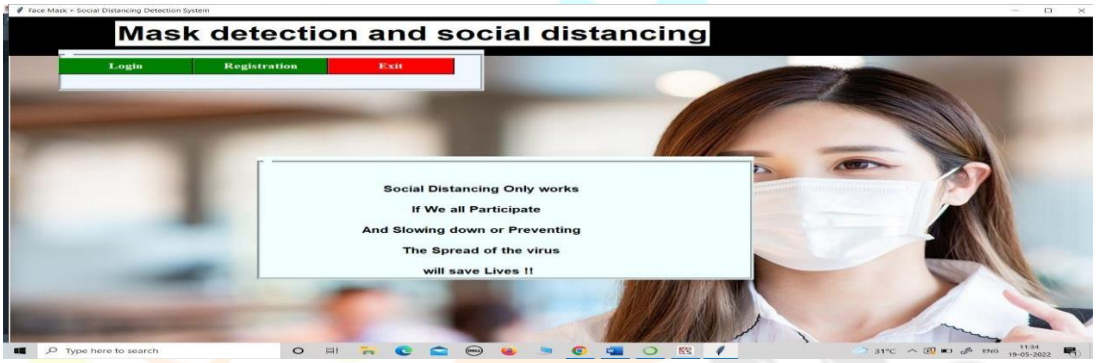
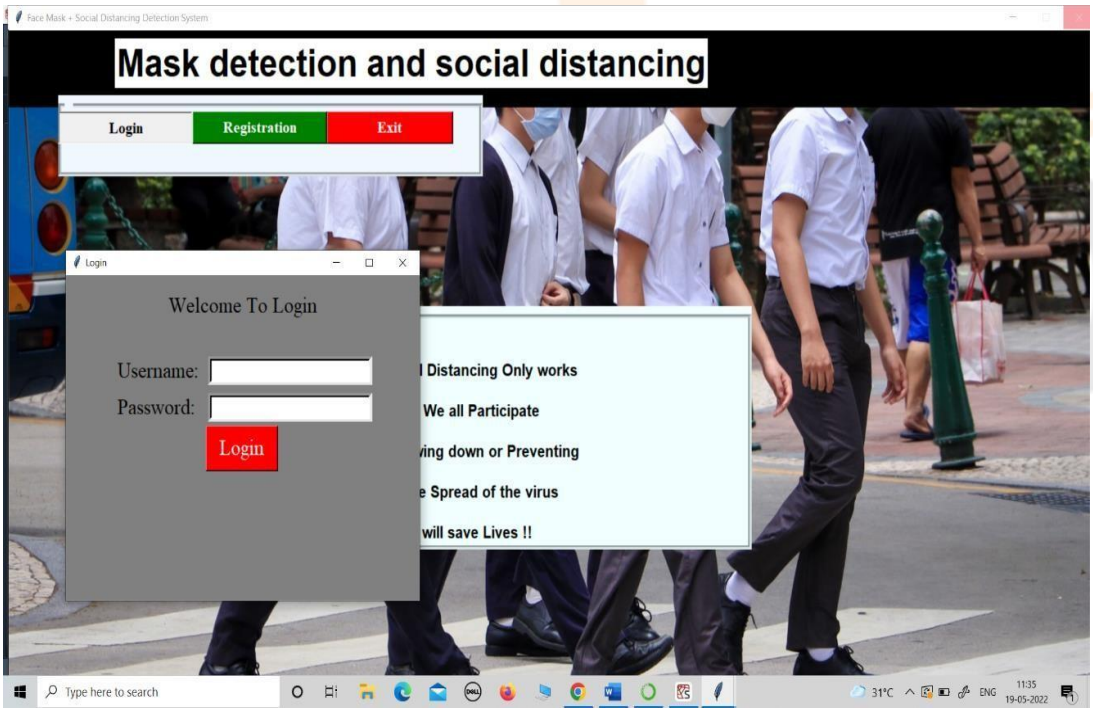


Fig 1.Welcome Page

Welcome Page consists of 3 options Login , Registration and exit. When chosen Login option, we get redirected to the login page, when chosen Registration, redirects to the registration page and exit terminates the current window

When choosing the registration option , a registration window is displayed which consist of information such as Full Name, Address, Email, Phone number, Gender, age, Username, Password, confirm password, etc.



When Chosen Login or after completing registration, Login page gets opened. Login page contains details such as Username and Password.

Here, there are 3 options which include mask detection, social distancing and Exit. Mask detection option when chosen redirects to the window detecting our mask, Social Distancing detects if the people in the frame are keeping appropriate distance or not, and exit option exits us from the current window.

When choosing a face mask detection option, a window opens which captures the live stream and displays if the person is wearing a face mask or not. If the person in front of the camera is not wearing the mask then a red square appears surrounding the person's face.

If the person is wearing a mask properly then, a green boundary square appears around the face of the person with the percentage of mask properly worn.

6 Challenges for future research work

The following shortcomings of the previous study could be solved by researchers in the future after analyzing the current body of work:

- Limited dataset: The dataset was a limitation in the majority of the publications we looked at. Limited data sets may make it difficult to train the model during that time.
- Speed for real-time object identification: Due to the complexity of the methods utilized, it may take longer to analyse and present additional findings.

- Multiple scales of objects had to be recorded, and if they weren't, the model might need to be precisely scaled.
- Lack of data quality — the training dataset needs to be well organized. If not, the model may be impacted by the quality of the data.
- Coughing and sneezing: According to WHO standards, persistent coughing and sneezing are two of the main signs of COVID-19 infection and one of the main ways the disease is disseminated to people who are not affected. By enhancing our suggested solution with body gesture analysis to determine whether someone is coughing and sneezing in public places while violating the rules regarding the use of a facial mask and social distance, a deep learning-based approach can be useful in this situation to detect and limit the spread of disease. Based on the results, enforcement agencies can be informed.
- Temperature Screening: An additional key symptom of COVID-19 infection is an elevated body temperature. Currently, thermal screening is done using handheld contactless IR thermometers, which require the health care provider to be in close proximity to the person being screened. This puts the health care provider at risk for infection and makes it difficult to take the temperature of every person in public places. The proposed use case can be equipped with:

7 Conclusion

Thus in this paper we discussed about the image preprocessing using color conversion and other techniques, then training them using a customized Convolutional neural network having 5 layers.Further we tested the CNN and yolo trained models which was able to identify if the person is masked or not and whether the people in the frame are following social distancing or not.

REFERENCES

[1] Hui D S, I Azhar E, Madani T A, et al. The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health—The latest 2019 novel coronavirus outbreak in Wuhan, China.INTERNATIONAL JOURNAL OF INFECTIOUS DISEASES, 2020, 91: 264-266

[2] Liu Y, Sun P, Highsmith M R, et al. Performance comparison of deep learning techniques for recognizing birds in aerial images//2018 IEEE Third International Conference on Data Science in Cyberspace (DSC). IEEE, 2018: 317-324

[3] Chen X, Kundu K, Zhu Y, et al. 3d object proposals for accurate object class detection//Advances in Neural Information Processing Systems. 2015: 424-432

[4] Liu W, Anguelov D, Erhan D, et al. Ssd: Single shot multibox detector//European conference on computer vision. Springer, Cham, 2016: 21-37

[5] Yang F, Choi W, Lin Y. Exploit All the Layers: Fast and Accurate CNN Object Detector with Scale Dependent Pooling and Cascaded Rejection Classifiers//2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR). IEEE Computer Society, 2016.

[6] Dong, E.; Du, H.; Gardner, L. An interactive web-based dashboard to track COVID-19 in real time. Lancet Infect. Dis. 2020, 20, 533–534. [CrossRef].

[7] Tribune. Govt to End Lockdown from 9th in Phases. The Express Tribune, 7 May 2020

[8] Greenhalgh, T.; Schmid, M.B.; Czypionka, T.; Bassler, D.; Gruer, L. Face masks for the public during the covid-19 crisis. BMJ 2020, 369, m1435. [CrossRef] [PubMed]

[9] Aruna, A.; Mol, Y.B.; Delcy, G.; Muthukumaran, N. Arduino Powered Obstacles Avoidance for Visually Impaired Person. Asian J. Appl. Sci. Technol. 2018, 2, 101–106.

[10] Jayapradha, S.; Vincent, P.D.R. An IOT based Human healthcare system using Arduino Uno board. In Proceedings of the IEEE 2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT), Kerala, India, 6–7 July 2017; pp. 880–885.

[11] Qiao S., Liu C., Shen W., Yuille A. Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition. 2018. Few-Shot Image Recognition by Predicting Parameters from Activations.

[12] Kumar A., Zhang Z.J., Lyu H. Object detection in real time based on improved single shot multi-box detector algorithm. J. Wireless Com. Netw. 2020;2020:204. doi: 10.1186/s13638-020- 01826

[13]Morera Á., Sánchez Á., Moreno A.B., Sappa Á.D., Vélez J.F. SSD vs. YOLO for detection of outdoor urban advertising panels under multiple variabilities. Sensors (Switzerland) 2020 doi: 10.3390/s20164587. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

[14]Girshick R., Donahue J., Darrell T., Malik J. Region-based Convolutional Networks for Accurate Object Detection and

Segmentation. IEEE Trans. Pattern Anal. Mach. Intell. 2015;38(1):142–158. doi: 10.1109/TPAMI.2015.2437384. [PubMed] [CrossRef] [Google
Scholar]

[15] He K., Zhang X., Ren S., Sun J. Spatial Pyramid Pooling in Deep Convolutional Networks for Visual Recognition. IEEE Trans. Pattern Anal. Mach. Intell. 2015 doi: 10.1109/TPAMI.2015.2389824. 18] R. Girshick, Fast R-CNN, in: Proc. IEEE Int. Conf. Comput. Vis., vol. 2015 Inter, 2015, pp. 1440–1448, doi: 10.1109/ICCV.2015.169.

[16] Nguyen N.D., Do T., Ngo T.D., Le D.D. An Evaluation of Deep Learning Methods for Small Object Detection. J. Electr. Comput. Eng. 2020;2020 doi: 10.1155/2020/3189691.

[17] Cai Z., Fan Q., Feris R.S., Vasconcelos N. A unified multi-scale deep convolutional neural network for fast object detection. Lect. Notes Comput. Sci. (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 2016 doi: 10.1007/978-3-319-46493- 0_22. 21] C.-Y. Fu, W. Liu, A. Ranga, A. Tyagi, A.C. Berg, DSSD : Deconvolutional Single Shot Detector, 2017, arXiv preprint arXiv:1701.06659 (2017).

[18] A. Shrivastava, R. Sukthankar, J. Malik, A. Gupta, Beyond Skip Connections: Top-Down Modulation for Object Detection, 2016, arXiv preprint arXiv:1612.06851 (2016).

[19] N. Dvornik, K. Shmelkov, J. Mairal, C. Schmid, BlitzNet: A Real-Time Deep Network for Scene Understanding, in: Proceedings of the IEEE International Conference on Computer Vision, 2017, doi: 10.1109/ICCV.2017.447.

[20] Z. Liang, J. Shao, D. Zhang, L. Gao, Small object detection using deep feature pyramid networks, in: Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 2018, vol. 11166 LNCS, pp. 554–564, doi: 10.1007/978-3-030-00764-5_51.

[21] K. He, G. Gkioxari, P. Dollar, R. Girshick, Mask R-CNN, in: Proc. IEEE Int. Conf. Computer Vis., vol. 2017-Octob, 2017, pp. 2980–2988, doi: 10.1109/ICCV.2017.322.

[22] P. Soviany, R.T. Ionescu, Optimizing the trade-off between single-stage and two-stage deep object detectors using image difficulty prediction, in: Proc. - 2018 20th Int. Symp. Symb. Number. Algorithms Sci. Comput. SYNASC 2018, 2018, pp. 209–214, doi: 10.1109/SYNASC.2018.00041.

[23] Lin T.Y., Goyal P., Girshick R., He K., Dollar P. Focal Loss for Dense Object Detection. IEEE Trans. Pattern Anal. Mach. Intell. 2020 doi: 10.1109/TPAMI.2018.2858826. 28] J. Deng,
W. Dong, R. Socher, L.-J. Li, Kai Li, Li Fei-Fei, ImageNet: A large-scale hierarchical image database, 2010, doi: 10.1109/cvpr.2009.5206848.

[24] T. Y. Lin et al., Microsoft COCO: Common objects in context, in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 2014, vol. 8693 LNCS, no. PART 5, pp. 740–755, doi: 10.1007/978-3-319- 10602-1_48.

[25] Apostolopoulos I.D., Mpesiana T.A. Covid-19: automatic detection from X-ray images utilizing transfer learning with convolutional neural networks. Phys. Eng. Sci. Med. 2020 doi: 10.1007/s13246-020-00865-4.

[26] "MobileNets: Efficient Convolutional Neural Network for Mobile Vision Application", Andrew G. Howard, Menglon Zhu, Bo chen, Dmitry, ACM 17 Apr 2017, arXiv:1704.04861v1 cs.CV

[27] "MobileNet convolutional Neural Network and support vector machine for Palmprint recognition", Auelia Michele, Vincent Colin , Dia Santika, ScienceDirect Procedia Computer Science 157 (2019) 110-117, doi: 10.1016/j.procs.2019.08.147

[28] Jadhav, S., Garg, B. (2023). Comparative Analysis of Image Segmentation Techniques for Real Field Crop Images. In: Gupta, D., Khanna, A., Bhattacharyya, S., Hassanien, A.E., Anand, S., Jaiswal, A. (eds) International Conference on Innovative Computing and Communications. Lecture Notes in Networks and Systems, vol 471. Springer, Singapore. https://doi.org/10.1007/978-981-19-2535-1_1

[29] Jadhav, S., Garg, B. (2022). Comprehensive Review on Machine Learning for Plant Disease Identification and Classification with Image Processing. In: Agarwal, B., Rahman, A., Patnaik, S., Poonia, R.C. (eds) Proceedings of International Conference on Intelligent Cyber-Physical Systems. Algorithms for Intelligent Systems. Springer, Singapore. https://doi.org/10.1007/978-981-16-7136-4_20

[30] Suruchi Mishra, shruti yeole, Shital A. Karande, Sonali Shinde, Secure and Hassel Free Next Generation E-Voting Through Deep Learning Based Face Recognition, International Journal for Scientific Research in Engineering and Management, 2021.