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HUMAN PRESENCE DETECTION AND FACE MASK DETECTION USING DEEP LEARNING APPROACH

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Abstract - Convolutional Neural Networks have always given promising results in the use-cases of object detection. Due to the learning capabilities of neural networks, they are able to find hidden patterns in the architecture of the data. Using deep learning models in the image recognition field has always given good results. Using this approach we introduce a presence detection model that finds the presence of a person via camera and predicts the their availability from the trained images. The model first checks for mask detection based on Transfer Learning approach and predicts if the present person is wearing mask or not and further marks the presence.

Keywords - ***Mask Detection, MobileNetV2, CNN, Transfer Learning, HOG, Face Recognition, Attendance***

I. INTRODUCTION

From time to time, student attendance record has always been one of the most important issues for any school and university. Nowadays it seems a waste of time as it takes a lot of precious moments of people in which they could have achieved so much. Living in an era of modern high-tech science where most of the work is done by the help of robots and automated machines, manual attendance seems useless as it has a high chance of piracy and requires manpower.
As humans our brain is capable of doing all these tasks easily and instantaneously. When compared this to a computer, they are not able to do this level of recognition easily unless someone teaches them. To do so we need to train the computer of this classification where it is able to detect the human face and recognize them as individual persons.
To ease this attendance procedure many ideas have already been introduced like making a QR code to set attendance [8], signature recognition, voice recognition, iris recognition [11], etc. One of the techniques among these is of facial recognition. In this approach we capture the image of person from camera and try to detect the face using computer intelligence. We basically look for some of the common features that resembles a face like the nose, ears, lips, eyes, etc. After finding these we try to detect a full face of a person and match it with our data check for their presence.
Biometric system like one using the fingerprints have always been useful but they are time consuming as each person needs to do it by themselves, here the facial recognition systems has advantage over them as they can be used to identify a number of people easily by just looking at them.
We introduce a method to overcome this problem of teachers/organisations. The method proposed here is to way too simple and accurate in maintaining the presence record. It uses Machine Learning approach to detect faces and match them with our record of students and staff.

II. RELATED WORK

In [1] the author, for face recognition, first it converts the image to gray scale image the it uses the trained model to detect the faces.

In [2] the author, used the help of regression trees to detect the face. At each node the decision is based on thresholding a value of the difference of intensity values at a pair of pixels.

Four major categories of face detection approaches given by [3]: Template matching, Appearance-based approaches, Feature invariant, and Knowledge-based.

In [4] authors has compared various face detecting algorithms like haar feature face detection and geometric base face detection. Result of this is that haar feature extraction face detection approach is found as a really good algo for face detection.

In [5] the author used three different methods (svm, ensemble methods and decision tree) for mask detection and concluded that svm gave the best outputs with all the three datasets.

Anuradha Dhull et al. used unsupervised feature selection approach , ACO Meta-heuristic, to design CSDe system and ACO assisted decision tree for CADx system. [6]

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In [7] authors used YOLO to classify object in real time which can process 45 frames per second. The method outperforms RCNN and DPM methods.

In [8] the author offers a solution to use a QR code. The students will scan it through a smartphone application, code along with their student identity will confirm the students attendance.

B. K. Mohamed and C. Raghu proposed a portable fingerprint device which is passed to each of the student in which they will be marking their attendance by placing the finger on the sensor to get a match. But this problem has a problem that it will create disturbance in the class and is time consuming. [9]

In [10] authors suggests a RFID (Radio Frequency Identification) based attendance system in which every student carries a RFID tag card and they need to place that card onto a card reader which marks their attendance. This method can can lead to frauds as students can share the cards for attendance.
S. Kadry et al. proposed Daugman's algorithm based on iris recognition system in which they capture the iris and do extraction storing and then match with database[11].

In [12] suggests a method in which they used support vector machines with binary tree classification strategy for face recognition and the results show that SVM can perform better on face recognition than other nearest center approach.

Divya Jain et al. suggests a relief feature selection method to increase the efficiency for breast cancer classification and uses PCS for dimensionality reduction. The model is able to reduce 33% useless features. [13]

The authors propose a face detection approach which uses improved version of LBP, i.e. ILBP as facial representation. This method is robust to illumination variation and consider bith texture information and local shape instead of the raw gray scale information. [14]

Chengjun Liu et al. proposes a novel Bayesian Discrimination Features method for multiple frontal face detection which first finds features form input image and then apply statistical methods like conditional probability density function for face and nonface classes. Finally Bayesian classifier detects frontal fae. [15]

Anuradha et al. proposed a frequent itemset mining technique that is useful over the existing methods. The methodology is sensitive to sliding windows and gives higher accurate results and uses less memory with faster results. [16]

This paper does a research on image classification techniques, the methods involves the use of ANN and SVM which gives good results. [17]

In [18] authors have proposed method to detect facial features in colour images. They have first applied skin detection by using pixel based skin detector and then used image segmentation and edge detection to verify the facial features.

Peng Wang et al. proposed an eye detector using the data from FRGC 1.0 which gives results with accuracy of 94.5%. They have used Haar feature and RNDA feature to detect the eye locations. [19]

In [20] authors proposed a biometric attendance system that uses two approach for the attendance, first is to use the database created by the organisation for the staff and the second is to use Aadhar Central Identification Repository. The system sends alerts to students and parent for irregularity.

III. PROPOSED METHODOLOGY

The main goal of the proposed system is to enhance the existing system of taking normal attendance. This is the era where if people do not cover their faces with mask then they are very much prone to having several diseases like due to dust particles and mainly the virus COVID-19. This necessity of wearing masks hinders the face recognition process because for the process of recognition a camera needs an input face, if there is a mask ON then the computers can't recognise that person. To overcome this problem, here is proposed a face mask detector which asks the person to remove the face mask to mark their presence. It uses live camera to capture the face of the staff and match it with people in database.

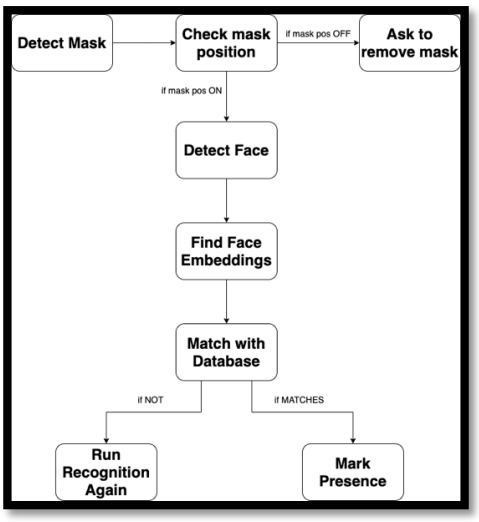

Fig. 1. Proposed Method for system

A. Dataset Description

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The dataset used for mask detection is taken from Kaggle which consists of various images with mask and without mask. To overcome the overfitting of the model the method of data augmentation is used to generate more images and train the model well.

B. Convolutional Neural Networks

CNNs are one the widely used methods used by researchers now-a-days. They have been applied in the field of image processing. CNNs are an inspired network from the connectivity structure of neurons of the human brain. The computerised CNN have kernels or filters, which extracts features from the input images by hovering the kernels over the images from one starting point. The advancement of machine learning algorithms has helped to increase the precision in the area of deep learning and CNN plays a vital role in the success.

C. Transfer Learning

Transfer Learning is very impressive technique that is used to increase the efficiency of the models and saves a lot if computation time. This method is based on the idea if using the previously learned patterns to attain a better performing model. It uses the weights and knowledge from previously trained that already know about the shaped, edges, etc, to implement on the new model which has less data to train on.

D. MobileNetV2

MobileNetV2 are small, low latency and powerful models that performs well on variety of use cases. They are built for efficient working of the mobile phones and gives faster results. The second version of this model is based on the same depth wise separable convolutions as building blocks, but in addition the second version has some linear hindrances between its layers and some shortcut connections between the layers.

E. Mask Detection

After the COVID-19 outbreak in Wuhan, China came into play many lives were lost at a rate never seen before. World Health Organization (WHO) confirmed that this is a dangerous virus which spreads via droplets in the air and humans are very much prone to it. To prevent the infection many measures were announced in which wearing a face mask is also included. As this mask has become the new trend, people usually wear it every time. So, many times people forget to remove them while marking their presence or attendance.

To overcome this issue a face mask detector is introduced which will warn the person before the camera if they are wearing mask while marking presence.

But to detect mask from a face, the first problem that rose was how to find a face from the input image. To overcome this, pretrained Deep Learning models are used to detect the faces.
To detect the mask presence the method of transfer learning is implemented which use MobileNetV2 to train itself with the help of weights ‘imagenet’, largest database trained with various categories used for visual recognition. Moreover, some of CNN layers are added to get pretty good accuracy. With this model the results are pretty good. The MobileNetV2 model is mainly used its low parameters and high efficiency of working with mobile phones which means it can be used with small tech devices efficiently.

(a)

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(b)
Fig. 2. Images from dataset (a) with mask (b) without mask [24]

F. Mask Position

After training the model on ModelNetV2, results obtained are very accurate that helped in precise detection of masks. Before this stage of detection some statistical calculations are performed which have increased the accuracy and finally mask presence is detected.

G. Face Detection

The Science and computer vision are so developed today that they can do many mind-blowing things using computer which was just a thing of dreams only. Face detection is a method in which a computer can detect a human face from images and videos. Many of today's mobile phones already include this feature of automatic face detection which enhances the image quality and makes it more presentable.
After being able to detect and classify the mask ONN and OFF the research moved to detect person face to get it matched with the database[24]. The method of HOG – Histogram of Oriented Gradients is used at the backend. It has achieved great efficiency while detecting the face of a human from an image. After this process the system moves to recognise the face of the person.

H. Face Recognition

Face encodings are a way to represent face of human using 128 computer generated measurements which depends on the size of eye and its shape, lips size and shape, colour of skin, etc. All the factors together make these 128 measurements. Two different pictures of same person have similar encodings and two different people will have totally different encoding.
To recognise the face the proposed system tries to find the facial landmarks from the input image (total 68), but they are not sufficient for face recognition as it would take a lot of time to recognise a person from a huge database. As everyone know computers works best with the numbers, to overcome this the embeddings of the face are captured and for the recognition process.
This method is very much fast and accurate in finding the person and matching it with the previous parsed data. It proved to be amazingly fast and efficient. The moment it got the face encoding from the input image, it compares them with the encodings of the database and choose the image which has the minimum face distance.

I. Database Comparison

Once the image is captured, the system records its face encoding and they are compared with the encoding of peoples from the database[24]. If a person standing before the camera matches with any of the encodings from the database[24], then their presence is marked into a excel sheet with the data and time when the image was recognised and matched with the data.

IV. EXPERIMENTAL ANALYSIS

When starting with experiment to check the feasibility of the Face Recognition System, it first starts the webcam and detects the face of the person and checks if it is wearing mask or not. If the person is ON mask, then it asks the person to remove (by displaying a message on the screen) to get their face recognised for marking. The accuracy of the mask detector is 98.7%. Because of the use of transfer learning the model built is very accurate and has minimal loss.

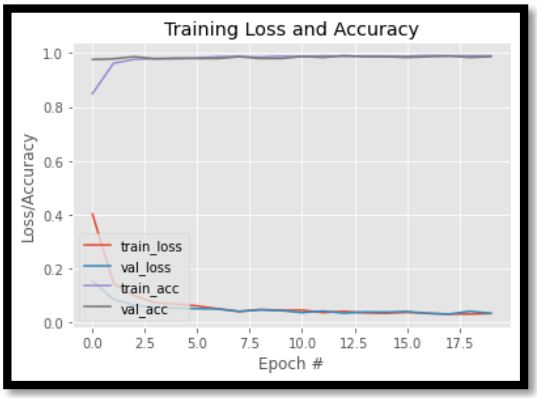

Fig. 3. Comparison of loss and accuracy with number of epochs

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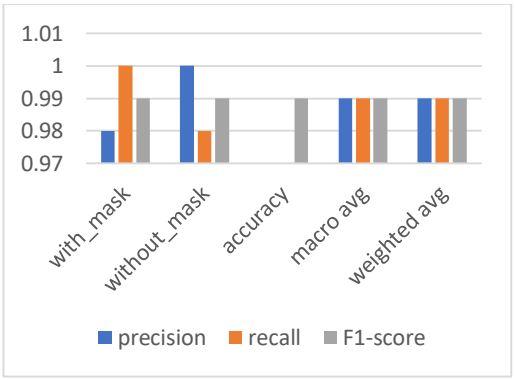
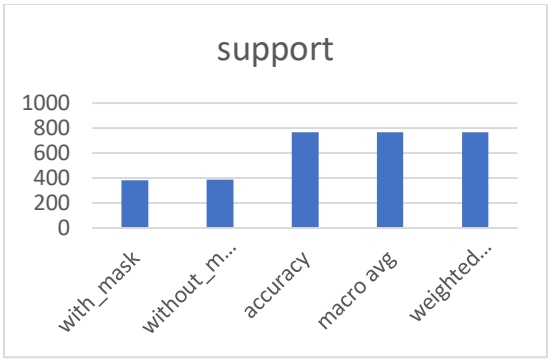
Table - 1 Classification report

Parameter	Precision	Recall	F1-score	Support
Results(with_mask)	0.98	1.00	0.99	383
Results (without_mask)	1.00	0.98	0.99	384
accuracy	0.99	0.96	0.99	767
macro avg	0.99	0.99	0.99	767
weighted avg	0.99	0.99	0.99	767



(a)



(b)

Fig. 4. Graph for with mask and without mask report (a) Precision, recall, f1-score (b) support

Table - 2 Accuracy Comparison

Method Used	Accuracy	Reference
Network Fusion + JB	88.70	[21]
LRC	88.06	[22]
C2D-CNN	91.98	[23]
Proposed Method	99.38	-

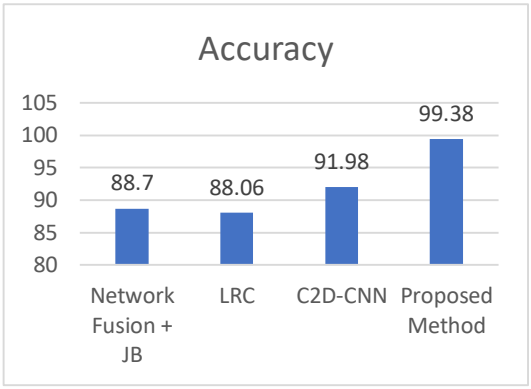


Fig. 5. Accuracy comparison visualisation

After getting the visual of a NON-MASK face, the system parse that image to the function where it first loads the sample images from the specified path and calculates their face encodings (which are 128 measurements of the face) and saves it in a variable for further use. Then the system detects the face from input image, with an accuracy of 99.38%, and gets its encodings to match it with the database encodings.
If the input image encodings get a match with one from the database, then it parses the recognised person's name to a function for the process of marking the presence or attendance. To get a face recognised and match making of the input image with data every facial landmark is needed and eyes plays the most important role here
The attendance functions get the date and time of that person from the moment it recognises and matches with the data and appends it into an excel sheet.
So far, the system is able to easily recognise a person whether they are in a different facial getup (like facial beards, smile face, etc).

V. CONCLUSION

By capturing of the image from input camera and applying techniques for face detection and recognition can decrease the manual work of humans and can help in increasing the security. This proposed system can be used to reduce manual work and increase accuracy like as an automated attendance system, security purposes, police work like recognising thieves and other criminals.

The methods used in this face attendance system gives accurate results. So this can be further implemented in various fields to increase the efficiency and reduce the human involvement. The mask detector model used in this work can be used for devices like mobile phones because of its low latency and high efficiency.

This work can be used for face recognition systems for police departments to identify criminals, by security departments to detect defaulter people without face

mask, at organisations as their base facial attendance system, etc

One of the latest examples can be the technology used in Amazon Go stores which uses Deep Learning and Image Processing to create human free stores. Right now, we have used this attendance system to be implemented as a better alternative to help schools and universities in marking the attendance of their staff and respective students with a superior accuracy.

VI. REFERENCES

[1] Soo, S. (2014). Object detection using Haar-cascade Classifier. *Institute of Computer Science, University of Tartu*, *2*(3), 1-12.

[2] Kazemi, V., & Sullivan, J. (2014). One millisecond face alignment with an ensemble of regression trees. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 1867-1874).

[3] Yang, M. H., Kriegman, D. J., & Ahuja, N. (2002). Detecting faces in images: A survey. *IEEE Transactions on pattern analysis and machine intelligence*, *24*(1), 34-58.

[4] Chauhan, M., & Sakle, M. (2014). Study & analysis of different face detection techniques. *International Journal of Computer Science and Information Technologies*, *5*(2), 1615-1618.

[5] Loey, M., Manogaran, G., Taha, M. H. N., & Khalifa, N. E. M. (2021). A hybrid deep transfer learning model with machine learning methods for face mask detection in the era of the COVID-19 pandemic. *Measurement*, *167*, 108288.

[6] Dhull, A., Khanna, K., Singh, A., & Gupta, G. (2019). ACO Inspired Computer-aided Detection/Diagnosis (CADe/CADx) Model for Medical Data Classification. *Recent Patents on Computer Science*, *12*(4), 250-259.

[7] Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. (2016). You only look once: Unified, real-time object detection. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 779-788).

[8] Masalha, F., & Hirzallah, N. (2014). A students attendance system using QR code. *International Journal of Advanced Computer Science and Applications*, *5*(3), 75-79.

[9] Mohamed, B. K., & Raghu, C. V. (2012, December). Fingerprint attendance system for classroom needs. In *2012 Annual IEEE India Conference (INDICON)* (pp. 433-438). IEEE.

[10] Lim, T. S., Sim, S. C., & Mansor, M. M. (2009, October). RFID based attendance system. In *2009 IEEE Symposium on Industrial Electronics & Applications* (Vol. 2, pp. 778-782). IEEE.

[11] Kadry, S., & Smaili, K. (2007). A design and implementation of a wireless iris recognition attendance management system. *Information Technology and control*, *36*(3).

[12] Guo, G., Li, S. Z., & Chan, K. (2000, March). Face recognition by support vector machines. In *Proceedings fourth IEEE international conference on automatic face and gesture recognition (cat. no. PR00580)* (pp. 196-201). IEEE.

[13] Jain, D., & Singh, V. (2018, December). Diagnosis of Breast Cancer and Diabetes using Hybrid Feature Selection Method. In *2018 Fifth International Conference on Parallel, Distributed and Grid Computing (PDGC)* (pp. 64-69). IEEE.

[14] Jin, H., Liu, Q., Lu, H., & Tong, X. (2004, December). Face detection using improved LBP under Bayesian framework. In *Third International Conference on Image and Graphics (ICIG'04)* (pp. 306-309). IEEE.

[15] Liu, C. (2003). A Bayesian discriminating features method for face detection. *IEEE transactions on pattern analysis and machine intelligence*, *25*(6), 725-740.

[16] Dhull, A., & Yadav, N. (2014). Mining Maximum frequent item sets over data streams using Transaction Sliding Window Techniques. *International Journal of Computer Science and Network Security*, *14*(2), 85-85.

[17] Nath, S. S., Mishra, G., Kar, J., Chakraborty, S., & Dey, N. (2014, July). A survey of image classification methods and techniques. In *2014 International conference on control, instrumentation, communication and computational technologies (ICCICCT)* (pp. 554-557). IEEE.

[18] Berbar, M. A., Kelash, H. M., & Kandeel, A. A. (2006, July). Faces and facial features detection in color images. In *Geometric Modeling and Imaging--New Trends (GMAI'06)* (pp. 209-214). IEEE.

[19] Wang, P., Green, M. B., Ji, Q., & Wayman, J. (2005, September). Automatic eye detection and its validation. In *2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'05)-Workshops* (pp. 164-164). IEEE.

[20] Dhanalakshmi, N., Kumar, S. G., & Sai, Y. P. (2017, January). Aadhaar based biometric attendance system using wireless fingerprint terminals. In *2017 IEEE 7th International*

Advance Computing Conference (IACC) (pp. 651-655). IEEE.

[21] Hu, G., Yang, Y., Yi, D., Kittler, J., Christmas, W., Li, S. Z., & Hospedales, T. (2015). When face recognition meets with deep learning: an evaluation of convolutional neural networks for face recognition. In *Proceedings of the IEEE international conference on computer vision workshops* (pp. 142-150).

[22] Khalajzadeh, H., Mansouri, M., & Teshnehlab, M. (2014). Face recognition using convolutional neural network and simple logistic classifier. In *Soft Computing in Industrial Applications* (pp. 197-207). Springer, Cham.

[23] Li, J., Qiu, T., Wen, C., Xie, K., & Wen, F. Q. (2018). Robust face recognition using the deep C2D-CNN model based on decision-level fusion. *Sensors*, *18*(7), 2080.

[24] https://github.com/chandrikadeb7/Face-Mask-Detection/tree/master/dataset