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Face Mask Attendance System Based on Image Recognition

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FACE MASK ATTENDANCE SYSTEM BASED ON IMAGE RECOGNITION

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***Abstract*—The Pandemic of 2020 have resulted in a new normal lifestyle of wearing mask in public places and follow social distancing. Hence to develop a model for recognizing a person wearing a mask had turned mandatory. The technology, Deep Convolutional Neural Network (CNN) is used as an integral part to train a model and also to classify the images. Identifying the name of the person with the mask on is a tough process, since most of the facial characteristics are hidden by the mask. The data set of person with mask and without mask is collected and a model is trained using CNN algorithm. Real time face recognition module OPEN CV is used to capture and classify the real time facial images from the input camera to perform CNN and to compare the image with the trained model to recognize the name of the person. Image processing is widely used in many applications like image recognition, feature extraction, pattern recognition etc. Here, pre-processing is done using histogram equalization. The data set of 10 pictures per person is used for training the CNN model. The region of the eyes and position of the mask is feature extracted and it is trained to recognize the person.XML python library helps to extract the required information from the image for further processing.**

***Keywords*—CNN, OPEN CV, Python, face mask recognizer.**

I. INTRODUCTION

Face recognition with mask detection, a new way of identifying the person with less information, since the rules of wearing mask in public places and follow social distancing is mandatory to reduce the spread of the virus. The education institutions are shut down and the teaching is made online. In order to open the institutions back, a proper planning has to be formed to monitor the students to combat the cluster of covid. Hence a real time system for mask detection and recognizing the person with mask is vital. The traditional methods of recognizing person like finger print senor is dangerous since there is a vulnerable of cluster formation of the virus. Therefore, it is mandate to develop a system to monitor the person with no direct contact. Recognizing the person with mask on is a tedious process, since most of the facial features remain hidden. Hence an algorithm has to be employed to recognize the person with less information of the facial characteristics. Image processing is widely used in many applications like image recognition, feature extraction, pattern recognition etc. Here, pre-processing is done using histogram equalization for getting required information from the picture. Feature extraction helps in reducing the amount of data that must be processed by combining variables into features. CNN deep learning algorithm is employed to assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. OPEN CV, a python library helps in implementing CNN and also used in the real time image recognition. Using the data set of person with and without mask a model is trained to recognize the person. With an input camera the real time images are compared with the trained model, thus the person gets identified. This paper [11] focuses on reducing the noise from the image using advance PCA technique (Principal Components Analysis) and the system also interfaces PCA technique with raspberry pi for better detection of face. The studied training model which focuses on the extraction of face mask [19]from a video sequence. Also this paper proposed a method for segmenting the facial features with better extraction of the patterns from the face using ConvLSTM (Integrating Convolutional LSTM)-FCN (Fully Convolutional Networks) model. This paper evaluated a technique [20] that incorporates deep learning and hand craft features in the objective function of the deep learning layer which ultimately increases the face recognition performance. Hand craft features includes the regions of nose, mouth and eye areas. This technique of combining hand craft features with deep learning is called as

Facial Texture Feature Aided Deep Learning Feature (FTFA- DLF) which achieved an accuracy rate of 97.02

The remainder of this paper is organized as follows. Section II, containsthe techniques and methodologies used for implementing the facial recognition system. . Section III, describes experimentalsetup and working procedure and also contains evaluation results. Finally, Section IV concludes the paper.

II. METHODOLOGY USED

Face recognition model make use of computer algorithms to extract specific, unique information about a person's face. The characteristics includes the distance between the shapes of the chin or eyes which are further converted into a mathematical form and it is compared with other faces from the face recognition database. Face template is formed using the dataof a particular face. Face recognition system are designed to compute a probability match pattern between specific face templates stored in the database and the unknown person. Concepts of pre-processing helps in improving the input raw image and reducing the external noise. In order to get the specific patterns from the image feature extraction is used. Facial features includes nose, eyes and region around mouth are extracted for further processing as shown in fig 1. Convolutional neural network (CNN) is employed for the process image comparison and classification. Using the library function OPEN CV(ComputerVision), CNN is executed.

A. PRE PROCESSING

Pre-processing deals with abstraction of images at the lowest level. It is done for both the input and output images. The images obtained after pre-processing usually is of the same kind of the original data but with enhanced image quality by suppressing unwilling distortion and enhancing the brightness and picture quality of those images. The intensity image obtained by pre-processing consists of matrix values representing the brightness of the picture. According to the size of the pixel neighborhood, image pre-processing methods are extended into four categories, which is used for calculation of a new pixel brightness.

Image pre-processing works primarily on redundancy in images. Usually the real images consists of pixels having same or similar value of brightness. Thus the distorted pixel image is solved by taking the average value of the neighboring pixels and restoring the average brightness value.

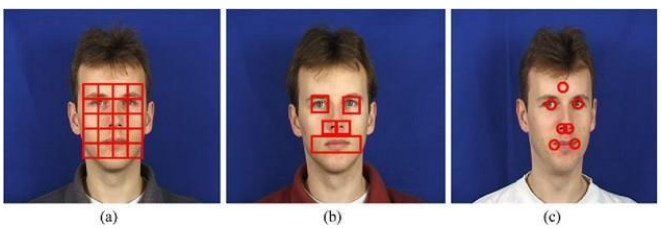


Fig. 1. Facial Features

B. FEATURE EXTRACTION

Feature extraction works on reducing data from the initial set of raw data. It is a part of the dimensionality reduction process, which organizes the initial raw data into reduced manageable groups, thus making image processing a lot faster and easier. A large data consists of large number of variables. Thus it becomes tedious to process those variables thereby requiring more computing resources. So feature extraction uses select and combine variables to get the best feature from those big data sets. The reduced data are easy to process also have the complete information of the actual data set with the same accuracy and originality. Hence, this technique plays a vital role in a case of reducing the number of resources without the loss of the relevant information from the data set. Feature extraction also reduces quantity of redundant data from the sets of data. It forms as a building block for reducing the machine's effort and also improves the speed of the learning model involved in the machine learning process. The fig 2 shows the block diagram of the system.

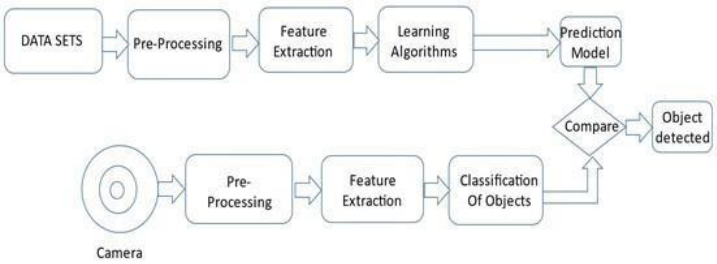


Fig. 2. Block diagram of the system

C. DEEP LEARNING

Deep learning (Deep neural learning or Deep neural net- work.) is one of the artificial intelligence (AI) function that has the ability to process data more efficiently than human brain, by creating patterns for decision making. Deep learning falls under the subset of machine leaning under artificial intelligence that consists of networks which have the capacity of unsupervised learning from data that is unlabeled or unstructured. Deep learning employs hierarchical level of artificial neural networks which is a non-linear approach of machine processing. The artificial neural networks consists of neuron nodes connected together like a web just like human brain. Neural networks comprises of many layers of nodes. Nodes contained within individual layers are linked to adjacent layers. More the number of layer, more the network becomes deeper. In an artificial neural network, corresponding weights are assigned to the nodes by the signals which travels between them. More effect is exerted on the next layer of nodes by a heavier weighted node. The output is produced by the final layer which complies the weighted inputs. Since deep learning deals with the processing of large amount of data, a powerful hardware is necessary to compute these complex mathematical calculations. With extreme large data of inputs, even an advanced hardware may take weeks to

process those deep learning computations. Huge information of data sets are fed for the deep learning systems to return accurate results. During the processing of data, artificial neural networks deals with classifying the data based on the received answers from sets of binary true or false questions consisting of highly complex mathematical calculations. A face recognition system is implemented by detecting and recognizing the lines and edges of faces. Probability of face recognition gets improved over the time the program is trained itself.

D. CONVOLUTIONAL NEURAL NETWOKS (CNN)

A convolutional neural network (ConvNet) uses a grid-like topology consisting of a feed-forward neural network which has the power to analyze visual images by processing data. A convolutional neural network is helpful in classifying and detecting objects in a picture. The basis of convolutional neural network is the operation of convolution. Convolutional Neural Network Layers: There are multiple hidden layers in a convolution that provides a way for extracting information from an image. Below consists of three important layers in CNN,

- Convolution layer
- Pooling layer
- Fully connected layer

The first layer of CNN is convolutional layer which helps in extracting specific features from the input image. This layer performs convolution operation between the input image and a filter. The dot product is taken with respect to the size of the filter between the filter and the parts of the input data by sliding the filter over the input image. The output obtained from the first layer is called as Feature Map which provides the information of corners and edges in an image. The resulted feature map is linked to other layers of CNN to learn various other features of the input image.

Pooling layer is the second layer next to convolutional layer. Pooling layer focus on decreasing the size of the convolution feature map that results in the reduction of computational costs. This can be achieved by reducing the number of connections between layers and operating independently on each feature map. The Pooling Layer acts as a bridge between the FC (Fully Connected) Layer and the convolutional Layer. Pooling layer contains many types of pooling operations depending upon the method used. There are two common pooling operations in this layer:

- Average Pooling
- Maximum Pooling (or Max Pooling)

Average pooling is used to calculate the average value for patches of a feature map. It is helpful in creating a down sampled feature map. Max Pooling is used to fetch the largest element is taken from feature map. The Fully Connected (FC) layer contains the neurons with the biases and weights. It is helpful in connecting neurons with two different layers. FC layer forms the last layer before the output layer in a CNN Architecture.

The obtained processed image from previous layers of CNN is fed to the FC layer to get a flattened vector. This vector the undergoes few more FC layers where usually the classification process is done.

E. OPEN CV

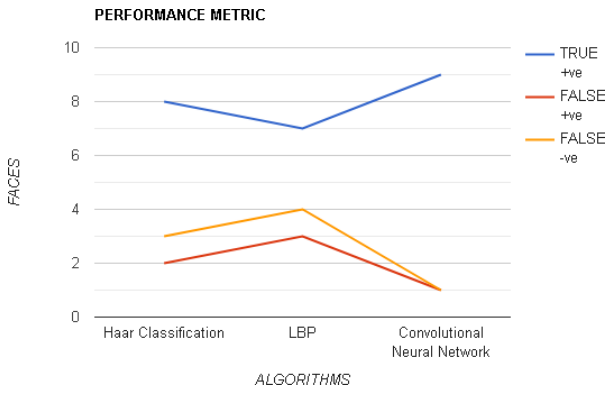
An open source machine learning software library called OPEN CV is built to give a common infrastructure for computer vision applications. It has the ability to accelerate the perception of machines. There are nearly twenty five thousand optimized algorithms that has the ability to track down the moving objects and camera movements, detect and recognize the unique facial features, classification of human actions, gather 3D models of objects, combine images together to get a higher quality image, searching similar pictures from the database, removing the red eyes from a photo, track own the eye movements, identify the scenery.

III. RESULTS AND DISCUSSION

The working procedure of this system is as follows, when a person is entering the class the camera automatically monitors the faces of the students and provide attendance for the students with mask. The system waits for a specified period for the students to enter the class after that period the person entering the class are marked as absent since they turned late for the class. The output can be viewed in a webpage and can be downloaded. The webpage contains the name of the students and their time of entry (if they are present).

A. PERFORMANCE METRIC

This system employs CNN algorithm over other methods due to its high accuracy and reliability over a given small set of datasets, where as other algorithms require a larger set of datasets to produce a same amount reliable accuracy. The comparison table of three algorithms are recorded as shown below in Table 1.The graph 1 shows the performance analysis.



Graph 1. Performance comparison

TABLE I
PERFORMANCE ANALYSIS

Analysis	Total Faces	Haar	LBP	CNN
True Positive	10	8	7	9
False Positive	10	2	3	1
False Negative	10	3	4	1
Detection Accuracy Rate		80%	70%	90%

B EXPERIMENTAL SETUP

The setup consists of Raspberry pi 3 module and Raspberry Pi camera module is shown in Fig.4. The dataset containing pictures of masked and unmasked are collected and dumped to Raspberry Pi 3 as shown in Fig.3. The collected images is used for training the model for differencing and classify those images based upon the information of facial features

Since most of the facial features are hidden, the CNN model trained in a way that it recognize the person even mask is present. The Pi module camera captures the input raw face data and those data is further Pre-processed to reduce distortion. Feature extracting placed in a vital role in acquiring relevant information from the image thereby reducing the size and complexity of the system.

C Execution of program

Facial feature are extracted from the data using the technique of feature extraction.

Step 1: Open the python idle terminal (Fig.5).

Step 2: Enter the file directory of the code in the terminal.

Step 3: In order to import library function and train model enter the command in the terminal as follows

"/pi-face-recognition $ python3 pi_face_recognition.py –cascade haarcascade_frontalface_default.xml + face detector…"

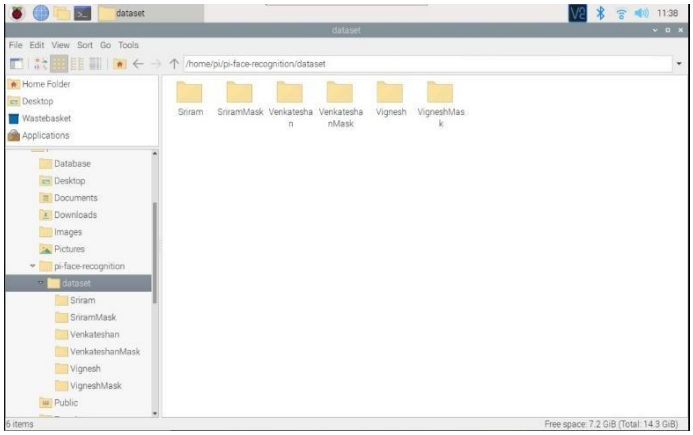


Fig. 3. Folder containing datasets

Step 4: Once the commands are entered in the terminal, the program runs in the background simultaneously video stream is turned on which capture the face of the person as shown in Fig.7 and Fig.8.

Sep 5: The video stream will be turned off once the delay of ninety seconds is completed.

Step 6: Once the delay is completed the program terminates and the attendance is dumped to web page as shown in Fig.6.

Fig. 4. Hardware setup

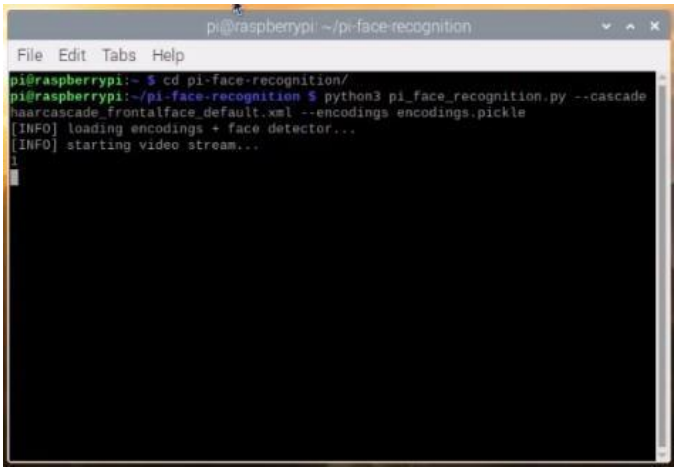


Fig. 5. Python IDLE terminal

D Final Output

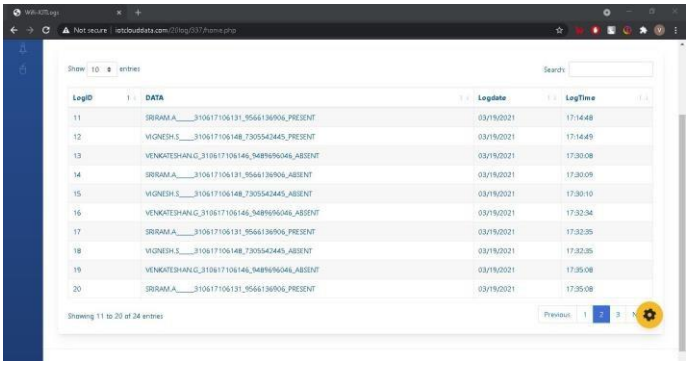


Fig. 6. Snapshot of the webpage

The attendance can be viewed using this link https://iotclou ddata/20log/337/index.php as shown in Fig.6. Once the login credentials is entered the web page is displayed. It contains the attendance status of the students including date and login time.

Fig. 7. Face Recognition without Mask

Fig. 8. Face Recognition with Mask

IV. CONCLUSION

Thus, the system recognize the identity of the person efficiently with less facial feature by interfacing Raspberry Pi with python machine learning module. Hence the CNN model is trained using python library function. Thus, the Open CV(computer vision) helps in real time face recognition. Graphical user interface (GUI) webpage is created which shows the attendance of the student.

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