Face Mask Detection

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Abstract

COVID-19 pandemic has rapidly affected our day-to-day life disrupting the world trade and movements. Wearing a protective face mask has become a new normal. In the near future, many public service providers will ask the customers to wear masks correctly to avail of their services. Therefore, face mask detection has become a crucial task to help global society.This paper presents a simplified approach to achieve this purpose using some basic Machine Learning packages like TensorFlow, Keras, OpenCV and Scikit-Learn. The proposed method detects the face from the image correctly and then identifies if it has a mask on it, mask is present but improperly worn or not present. We explore optimized values of parameters using the Sequential Convolutional Neural Network model to detect the presence of masks correctly without causing over-fitting.The approach is to train the provided dataset with different classifiers with and without feature extraction and filtering the best one based on accuracy on testing and training data.

Index Terms

KNN, decision tree, naive bayes.

I. Introduction

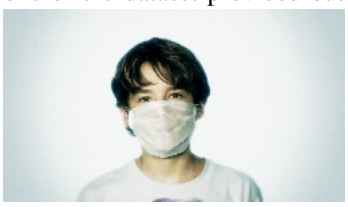
THE Face mask detection involves in detecting the location of the face and then determining whether it has a mask on it or not. The issue is proximately cognate to general object detection to detect the classes of objects. Face identification categorically deals with distinguishing a specific group of entities i.e. Face. It has numerous applications, such as autonomous driving, education, surveillance, and so on [5]. This paper presents a simplified approach to serve the above purpose using the basic Machine Learning (ML) packages such as OpenCV and Scikit-Learn.

In face detection method, a face is detected from an image that has several attributes in it. According to, research into face detection requires expression recognition, face tracking, and pose estimation. Given a solitary image, the challenge is to identify the face from the picture. Face detection is a difficult errand because the faces change in size, shape, color, etc and they are not immutable. It becomes a laborious job for opaque image impeded by some other thing not confronting camera, and so forth.

We have implemented KNN, Naive Bayes, decision tree with and withot hyperparameter tunng and CNN. The accuracy was found both by feature extraction using PCA and without it.

A. Dataset

Real-World-Masked-Face-Dataset was used to train and test the model. The dataset consisted of images of people with and without masks. The dataset was custoized and the images were addes in single folder for ease of training. The dataset of people wearing masks improperly was added manually to make the project more challenging. The dataset was pretty huge and consisted over 5000 images. It was splitted as 50% for training and testing data as instructed.We have fitted the classifiers on one of the dataset provided but the accuracy found was expected.Some images are as follows-




B. Preprocessing

As the dataset was mannualy customized there was not much need of preprocessiong. The data was splitted into required proportion i.e 50% for training and 50% for testing.The images with improper mask were added and were approximately 500 in number.

C. Incorporated Packages

1) Keras: Keras gives fundamental reflections and building units for creation and transportation of ML arrangements with high iteration velocity. It takes full advantage of the scalability and cross-platform capabilities of TensorFlow. The core data structures of Keras are layers and models [19]. All the layers used in the CNN model are implemented using Keras. Along with the conversion of the class vector to the binary class matrix in data processing, it helps to compile the overall model.

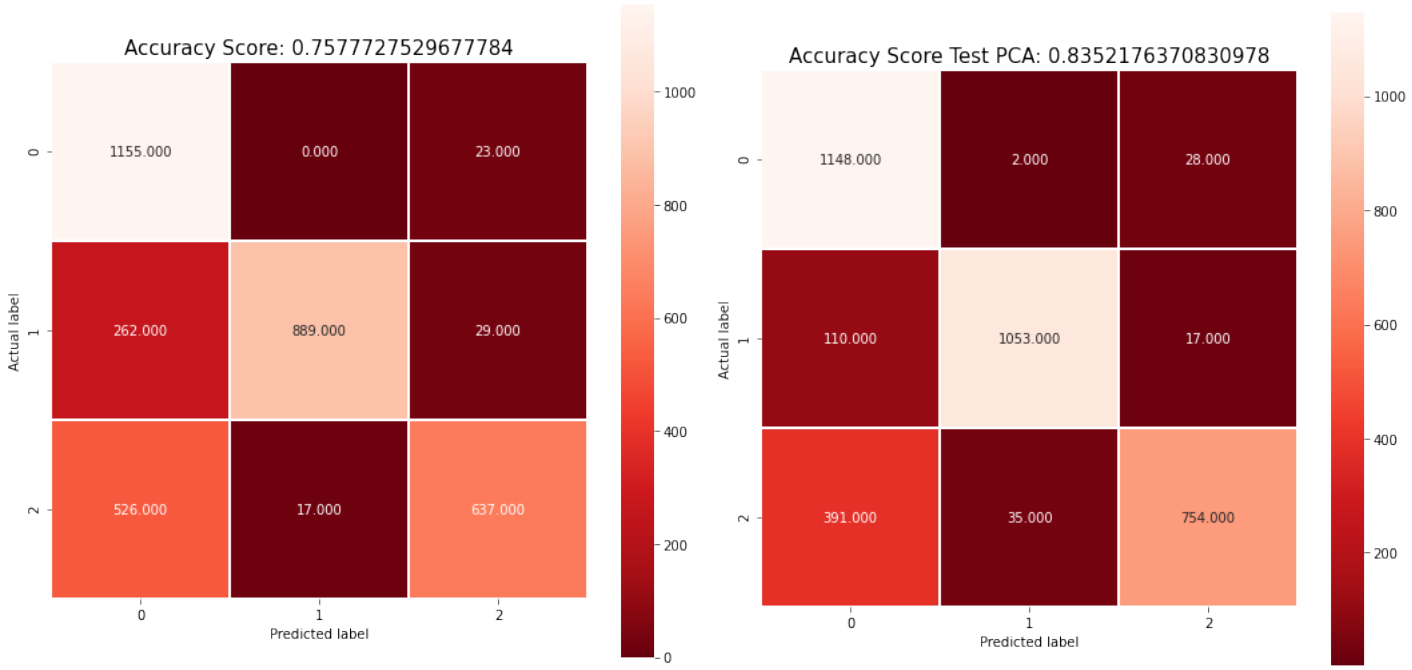
2) OpenCV: OpenCV (Open Source Computer Vision Library), an open-source computer vision and ML software library, is utilized to differentiate and recognize faces, recognize objects, group movements in recordings, trace progressive modules, follow eye gesture, track camera actions, expel red eyes from pictures taken utilizing flash, find comparative pictures from an image database, perceive landscape and set up markers to overlay it with increased reality and so forth [20]. The proposed method makes use of these features of OpenCV in resizing and color conversion of data images.

D. Classifiers Used

KNN, Naive Bayes, Decision tree and CNN classifiers were used to train the dataset provided.

1) KNN: Considering that this task is relatively simple, the model can be constructed with a relatively simple pattern recognition method. At the same time, in view of the deployment to the mobile phone terminal, the established model should be easy to deploy to the mobile phone terminal and convenient to maintain later. Compared with other algorithms, due to its simple implementation and significant classification performance, KNN is a very popular method in statistics and ranks top ten data mining algorithms.

KNN algorithm is different from model-based methods which first use training samples to build a model, and then predict the test samples through the learned model [48]–[49][50]. No training phase is required for the model-free KNN method. Instead, it conducts classification tasks obeying the following procedures: first, training samples are attached with labels; next, the distance is calculated between the test sample and the training samples in each label; subsequently, after comparing the distances and obtaining the tests nearest neighbors, the serial number is obtained; finally, classification is generated, as shown in Fig. 4. Considering the application scenario in our work, we finally utilize the Euclidean distance. The accuracy was found to be - Without PCA - 0.7577727529677784
With PCA - 0.8908050038872005
Confusion matrices for both are -



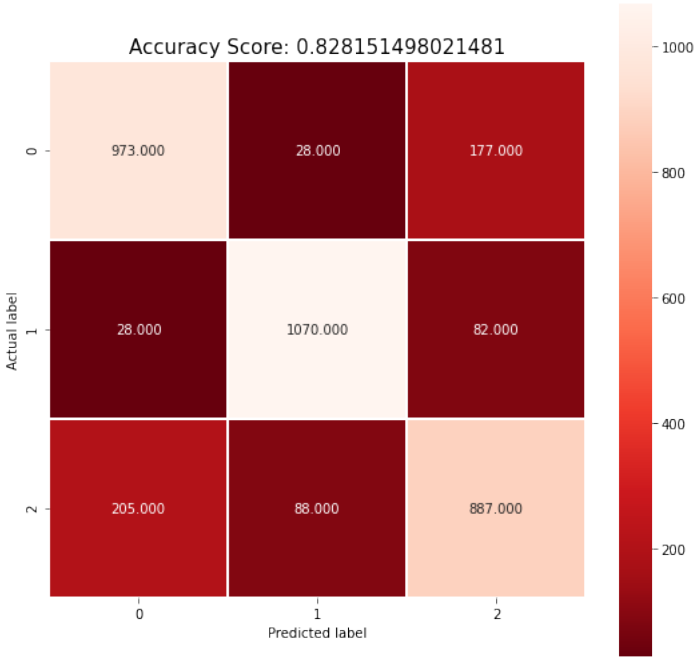
2) Decision Tree: A decision tree is a flowchart-like tree structure where an internal node represents feature(or attribute), the branch represents a decision rule, and each leaf node represents the outcome. The topmost node in a decision tree is known as the root node. It learns to partition on the basis of the attribute value. It partitions the tree in recursively manner call recursive partitioning. This flowchart-like structure helps you in decision making. It's visualization like a flowchart diagram which easily mimics the human level thinking. That is why decision trees are easy to understand and interpret.

Decision Tree is a white box type of ML algorithm. It shares internal decision-making logic, which is not available in the black box type of algorithms such as Neural Network. Its training time is faster compared to the neural network algorithm. The time complexity of decision trees is a function of the number of records and number of attributes in the given data. The

decision tree is a distribution-free or non-parametric method, which does not depend upon probability distribution assumptions. Decision trees can handle high dimensional data with good accuracy.Decision tree on the provided dataset implemented a fast detection speed through comparing pixel intensities between different nodes. A unified face detector was presented by [7], which combined detection and alignment in a model. In [8], a hierarchical DPM-based framework was developed to achieve face detection and keypoint localization.

The accuracy was found to be -0.828151498021481

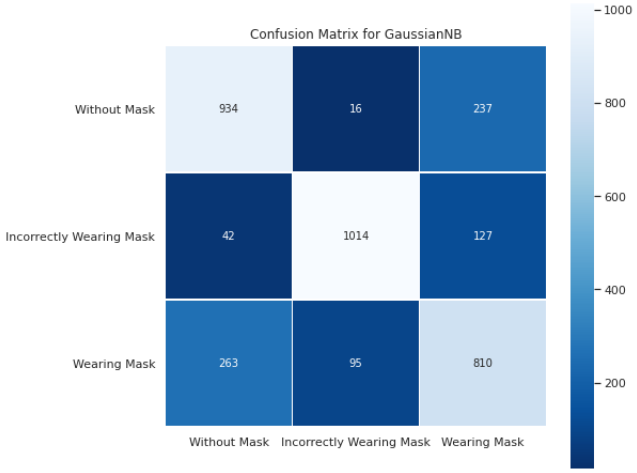
The confusion matrix for the same -



3) Naive Bayes: It is a classification technique based on Bayes' Theorem with an assumption of independence among predictors. In simple terms, a Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature.Even if these features depend on each other or upon the existence of the other features, all of these properties independently contribute to the probability that this fruit is an apple and that is why it is known as 'Naive'.Naive Bayes model is easy to build and particularly useful for very large data sets. Along with simplicity, Naive Bayes is known to outperform even highly sophisticated classification methods.Bayes theorem provides a way of calculating posterior probability P(c—x) from P(c), P(x) and P(x—c).Naive Bayes can be extended to real-valued attributes, most commonly by assuming a Gaussian distribution.This extension of naive Bayes is called Gaussian Naive Bayes. Other functions can be used to estimate the distribution of the data, but the Gaussian (or Normal distribution) is the easiest to work with because you only need to estimate the mean and the standard deviation from your training data.

The accuracy using this classifier was found to be - 0.779536

The confusion matrix for the same -



E. Additional Efforts

The third class was added to dataset namely the mask with improper wear which is really helpful in real life application. The feature extraction method of PCA was added to increase the accuracy of dataset before using KNN algorithm.

II. Conclusion

It was found that the accuracy of Decision tree classifier was highest among all three when the feature extraxtion method was not used. The accuaracy on KNN algorithm by applying PCA was found to be highest which is of 0.8908050038872005.

III. Contribution

Abhijeet Verma (B19CSE001) - Data preprocessing, compiling of dataset and Decision tree classifier
Adityaraje Devade(B19CSE005) - KNN and Naive Bayes Classifiers.

The report was made by combined efforts of all members.

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References

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