Recognition of Known faces between multiple Unknowns with high Accuracy

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Abstract: In colleges, universities, organizations, schools, and offices, identifying known and unknown faces is difficult sometimes for applications such as marking attendance in an auditorium with several students, during workshops, and many other applications. The main goal of this project is to identify known and unknown faces from a group image faster and accurately. For making such a system known faces are trained which then differentiates from unknown faces, for training the faces three main parameters i.e., Face recognition, Face detection and facial feature extraction should be done accurately and very fast and here in this paper it is done using the new emerging technique INSIGHTFACE.

It is a new emerging machine learning/deep learning approach, it avoids the hinderances like high processing time, large sample data collection for training, and low accuracy due to again and again training of machine learning modelling which are reported in traditional techniques like SVM, Neural networks and CNN.

For training known faces a hypothetical college MNCT is assumed in this dissertation where 6 persons are trained, one as a principal, two teachers and three students, The project is prepared in python version 3.10 with jupyter notebook, the project was successfully able to differentiate between known and unknown faces.

the complete facial analysis was done using Insight face, the extracted features of these trained person were stored in REDIS database system. And for detection of known face between multiple peoples consisting of known and unknown faces machine learning search algorithms are applied. The results obtained have 100 % accuracy, the faces are detected clearly even for a image which was having less resolution, during training of images insight face uses 10 to 11 samples only which are 10 to 15 times less compared to traditional techniques which reduces the processing time also.

Key words: Face Recognition, Insight Face, Redis

1. Introduction

In this project a model is implemented where the task is to detect known and unknown faces from a large set of images having multiple peoples. Firstly, the known faces are trained by collecting each sample person image by taking only 10 to 11 images. The training is done using insight face by extracting features and then storing those features in the database. The database chosen in this project is REDIS database. In traditional techniques the features are extracted and for giving accurate results at least 100 to 200 images are needed for training which reduces the model accuracy and takes larger time.

In present technique when the live image which needs to be checked and compared to detect the known faces and unknown faces, the features are extracted first again, then these facial features are compared with the stored facial features which were stored during the training of known peoples. For the searching and extracting accurate results machine learning search algorithm is used, typically there are different types of search algorithms which are earlier discussed in the theses but still the names of the search algorithms are provided here.

The figure 1 shows the diagram of the traditional techniques ways of detecting live images, these techniques were accurate but their accuracy decreases with the increase of sample size and larger processing time is taken due to again and again training of the complete model, also if the person needs to be added than whole model needs to be trained again which are certain demerits of these traditional techniques. In figure 2 the flow chart of proposed technique is shown in the proposed technique features which are extracted are stored in the database and it requires less images for training as discussed earlier and have higher efficiency in terms of accuracy and less processing time. The proposed technique is implemented on a hypothetical assumed college with the name say MNCT, in this college shri Narendra Modi is the principal, Barack Obama and Mr. Ramesh Singh is the teacher, and Shalini Singh who is the author of this dissertation is the student with two more students who are Angelina Jolie and Uditee Singh. The structure of this college is shown in figure 5.3

2. Related research work

Aale Rasool, Samra Roohi, and Anandaprova Majumder. (2020), The Authors proposed a system that takes attendance automatically which will use in academic institutions and it would generate more précised result compared to the handmade attendant paper by Aligned Face Dataset. Firstly, they added MTCNN next to Extract face embedding and noting they used FaceNet. they achieved very high accuracy but Author faced challenges when number of samples are large for training.
Jiachen Chen and W Kenneth Jenkins. (2017) the paper shows three different methods of facial recognition. Here, the authors try to show the comparison among the methods with various experiments like comparing different sizes of training daa average running time etc. Based on the comparison an acceptable identifying Sucess rate and the great runtime speed will be achieved. Although LDA has lower recognition accuracy than KNN and SVM. Authors struggled for accuracy for variations in pose.

Vidya Patil, Anushka Narayan, Vaishnavi Ausekar (2020) proposed a system that will track down the attendance by making use of facials recognition Where Viola-Jones and HAAR Cascade algorithm.is used for face detection of the students’, SVM, KNN has been utilized as a feature selection and recognition. For experimenting a dataset has been created with 5 students and 30 pictures of each student in different lighting conditions and dimensions of 92*112. Viola Jones is a framework for real-time image feature detection, where LDA is used to decrease the number of features utilized in a classifier. SVM and KNN are the classifiers, and when compared individually, KNM+LDA outperforms SVM+LDA in terms of precision, recall, and accuracy.

Turk, M., & Pentland, A (2019), demonstrate a Face Net and Support Vector Machine model of a university classroom attendance system Face Net was used to extract features, with 128 dimensions per face, and SVM was used to classify the given training data using the collected features. They used photographs of their classmates and celebrities from social media to collect data. Furthermore, they were able to obtain a 99.6% accuracy rate. As a result, they claim that the suggested system is capable of multi-face recognition. Even after comparing the proposed system to the VGG16 model on the same data set, the proposed system is more accurate.

2.1 Review Outcomes

• In the Traditional technique that uses Principal Component Analysis (PCA) to reduce the dimensionality of face images and represent them as a linear combination of eigenfaces. However, it may struggle with variations in pose, illumination, and occlusion.

• In the Traditional LBP (Local Binary Patterns) is a texture-based feature extraction method commonly used in face recognition. It captures local texture patterns in facial images. While LBP is computationally efficient, it may not capture high-level discriminative features effectively after training large samples again and again.

• Scale-Invariant Feature Transform (SIFT): SIFT is a traditional method that extracts local features invariant to scale, rotation, and affine transformations. It has been widely used in various computer vision tasks, including face recognition. However, SIFT-based approaches often require additional steps like feature matching and registration.

• Fisher faces, also known as Linear Discriminant Analysis (LDA), aims to maximize the between-class variance and minimize the within-class variance in face images. It is a classic technique for dimensionality reduction and classification. However, it is not be as effective capturing complex and discriminative features and 3D features.

Considering the demerits in the traditional work A new Technique is suggested now for face detection of 2d,3d, facial feature extraction, using DEEP LEARNING which is Insight face from the above outcome the authors have decided some objectives and are completed in the later section of the paper the objectives are:

• The Objective is to study the Face recognition, Face Feature Extraction and Detection Techniques by doing an Extensive Literature survey of Past and present new Techniques, currently Convolution neural network (CNN), Technique in Deep learning is the burning area.

• The aim is to Reduce the burden in the Training part i.e., in the Traditional methods the training is done using large data sets for face Feature extraction which requires large processing time and sometime give less accuracy, also as the number of samples increases the efficiency of the model to give accurate results decreases, so in the new model these demerits of traditional techniques will be eliminated.

• So, the research objective is to propose a new method which is Python with Redis Database and INSIGHTFACE which will extract the features with a very high accuracy and in this project the machine learning/deep learning algorithm of training part will be eliminated from further stage and in place of it the features will be saved directly in Redis database and during testing Machine learning search algorithms will be used for comparing the features and giving the output.

• Processing time will be low, accuracy will be high, training will require less samples and most Important Machine learning training algorithm which runs again and again for every test will be avoided, instead of model’s machine learning search algorithms are used.

3. Comparison between Traditional and Proposed techniques

From the literature outcomes and research objectives decided a comparison is shown using a flow chart diagram below.
Traditional Methods

Step 1
- Training Stage
  - Collection of a person Images
  - Feature Extractions
  - Support Vector Machine Neural Network
  - Convolutional Neural Network
  - Machine Learning/ Deep Learning Modelling
  - Save the Model

Step 2
- Implementing Stage
  - A live Person is coming in front of Camera
  - Features are Extracted

Processing Stage
  - Output

Figure 1 Traditional technique for Facial Image analysis

Proposed Method

Step 1
- Training Stage
  - Collection of a person Images
  - Feature Extractions
  - Directly save Features in REDIS Database
  - No need of Machine Learning / Deep Learning Modelling at this stage

Step 2
- Implementing Stage
  - A live Person is coming in front of Camera
  - Features are Compared Here Using Machine Learning Search Algorithms
  - Features are Extracted

Output

Figure 2 Proposed techniques for Facial Image analysis
A comparison of traditional techniques and proposed techniques is shown above in figure 1 and 2, the merits and demerit comparison are depicted in figure 3

**Disadvantages of the Technique**

- Required large samples of images for each person to train model [At least 100 to 200 images person.]
- Once model is trained, we cannot new person details into the model {Model need to retrain again with whole data}
- Accuracy of the model decrease as number of persons classifies increase.
- High processing time.

**Advantages of the Technique**

- Less samples.
- No model retrain required for new person.
- Good Accuracy
- Low processing time

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4. **Implementation of Research work**

The Implementation of the complete project goes in three stages.

- **First:** Assigning a hypothetical college and training of the guests
- **Second:** Storing of the Facial features in Redis database.
- **Third:** Machine learning Search Algorithms Implementation
- **Fourth:** Checking and Testing the accuracy of the model.

4.1 **Assigning and Training of Images**

- As discussed earlier in the introduction part that a college MNCT is assumed whose college principal, teachers and students are selected as shown in figure 4. firstly, these persons will be trained in INSIGHTFACE, training means the faces will be determined using the facial features values which are in integer type which is done using Insight face, the persons are assigned with the role and name.
- The goal of the project is that when an unknown image which is a mix of so many known and unknown faces is checked by the prepared model than the model detects the known faces with name, and role.
Figure 4: Assigning Designation of Principal, Teacher, and Students for a College for Considered Prediction

Figure 5: making the folder individually of each identity
In the above figure 5 and 6 firstly the folder is prepared providing name to a person with the role and finally in figure 6, 10 to 11 samples of each identity is collected for training purpose, as discussed earlier in this stage when training is done the target is to extract facial features of the sample data and to store them in Redis database. In the further part the complete process implemented in jupyter notebook is shown in the below windows. The codes are shown and finally figure 7 shows the extracted features of the trained images in the integer values.

```
In [1]: import os
   ...: import cv2
   ...: import numpy as np
   ...: import pandas as pd
   ...: from insightface.app import FaceAnalysis

In [2]: # configure face analysis
   ...: faceapp = FaceAnalysis(name='buffalo_sc',
   ...:                          root='insightface_model',
   ...:                          providers=['CPUExecutionProvider'])
   ...: faceapp.prepare(ctx_id=0, det_size=(640,640), det_thresh=0.5)
   ...: # warning: don't set det_thresh < 0.3

   ...: Applied providers: ['CPUExecutionProvider'], with options: {'Cider':{},
   ...:                                                              'find_model': 'insightface_model\models\buffalo_sc\det_500m.onnx'
   ...:                                                              '3', '?', '?'] 127.9 128.0
   ...: Applied providers: ['CPUExecutionProvider'], with options: {'Cider':{},
   ...:                                                              'find_model': 'insightface_model\models\buffalo_sc\w600k_mbf.onnx'
   ...:                                                              'None', 3, 112, 112] 127.5 127.5
   ...: set det-size: (640, 640)

Extract Facial Features and labels

In [3]: os.listdir(path='test_images')
Out[3]: ['principal_narendra_modi',
   ...:       'student_didi',
   ...:       'student_shalini',
   ...:       'student_udit',
   ...:       '']
```
Figure 7: Extracted Facial Features

5. Checking and testing the accuracy of the model.

For the final testing part, the sample images are collected where there is a combination of known and unknown peoples. Known and unknown peoples mean those faces which are trained are known and those which are not trained are unknown, for this for testing two sample images are taken as shown below in figure 8 (a) and (b). In the first image we know teacher Ramesh sing is present with 7 other unknown faces and in the next image 2 known student Shalini and student Uditeer are present with 5 unknowns. The images are called in the project by the below codes shown in an pop up window below.

```
In [77]:
test_image = cv2.imread('test_images/test_2.jpeg')
cv2.imshow('test_image', test_image)
cv2.waitKey()
cv2.destroyAllWindows()
```
Now these two testing images are searched with machine learning search algorithms which are implemented, for connecting the Insight face model with search algorithms to obtain the final testing results, way of displaying the output a final code is given which completes the proposed work. figure 9 and 10 shows the results displayed. With accuracy
6. Results description

➢ Firstly, Face recognition, Face detection and facial feature extraction is be done accurately and very fast using INSIGHTFACE alone with 100 % accuracy. In the starting a sample image of 23 persons were considered and every single person face, feature, gender is accurately predicted with detection score.

➢ The Insight face is used in an application of taking attendance in an assumed college [MNCT] were 1 principal, 2 teachers and 3 students were assumed and trained with 10 each sample images. They have been assigned with their name and roles; the features extracted from insight face are stored in Redis database again. During the implementation part when the trained image is a part of 7 to 10 unknown faces then the face is detected by name and role of the person with 100 % accuracy

➢ the hinderances like high processing time, large sample data collection for training, and low accuracy due to again and again training of machine learning modelling which are reported in traditional techniques like SVM, Neural networks and CNN is avoided in this work.

➢ The face can be detected even between more than 100 faces in a group easily, and for attendance system part if done than complete group photo of the class can be detected and attendance can be marked but every single student needs a training forst of there images whose extracted features only will be stored.

7. Conclusion

• In this project a very accurate way for doing multiple tasks of face classification, detection, facial feature extraction with age, gender, and high detection score is implemented using Insight face which is better than traditional techniques, this technique is better in noise, changed poses and for a large image with multiple faces, the technique can identify easily and detect all the faces and can extract facial features

• For building any project now relating to 2D, 3D Image Analysis insight face can be utilised for faster detection and extraction, in this dissertation the idea was to detect known and unknown persons, here a college was assumed and in the results it is shown that known persons who were trained were detected between so many unknown persons, this will help in differentiating many students of one college mixed with different college students during intercollege games, auditoriums functions, for fast attendance during seminars, webinars, workshops and many other events.

• The project utilises Redis Database for storing the Facial Features Extracted from Insight face, this reduces the burden of running Machine learning models like SVM, neural networks, which were used traditionally. instead, a search algorithm based on distance or similarity method finds the features of all the person who come during testing without running and accessing all the stored images but only uses integer type values of facial features and gives accurate results.

• In this project single known person was tested with unknown peoples and two known persons were tested with unknowns the result was accurate and 100 % correct
8. Future Work

- The model can be implemented in the application of detecting criminals from a large image very fast, finding lost kids, for kids training of image must be done very accurately but. In future there are multiple applications where faster results are expected those can be achieved using Insight face and Redis with python

References


