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# Face Recognition Robust to Image Resolution

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**ABSTRACT—**

In recent years, face recognition becomes a very important tool in the day-to-day life. Numerous applications, including automatic phone unlocking, border control, public monitoring, and many more practical ones, have been made possible by the ongoing advancement of face recognition systems. The integrated method for robust face identification from low resolution images is proposed in this paper. Oversampling techniques are used to compensate for the facial region of interest's low resolution. The model is fine tunned such a way that it will give the accurate result when low-resolution and high-resolution images compared. We will use Largely used datasets, such as VGGFace2, focus on gender, pose and age variations trying to balance them in order to achieve better results also the datasets such as LFW, XQLFW.Keywords—Triplet Loss, PyTorch, OpenCv, RetinaFace, 3D Face Recoconstruction, DataSet.

## I. Introduction

A facial recognition system is a piece of technology that can compare a human face in a digital photo or video frame to a database of faces. Such a technology locates and measures face features from an image and is often used to authenticate individuals through ID verification services.

Similar systems started to be developed in the 1960s as a type of computer application. Since their creation, facial recognition systems have been used more widely in robots, cellphones, and other fields of technology. Computerized facial recognition systems fall under the category of biometrics since they measure physiological traits unique to humans. Despite having a lesser level of accuracy than iris recognition as a biometric technique, facial recognition systems.In this paper, we have compared various techniques, methods and parameters and also figured out the pros and cons with these techniques. While comparing the approaches that were used, we figured out the areas which need to be improved.

## II. Related work

[1] OCTUPLET LOSS: MAKE FACE RECOGNITION ROBUST by Martin Konche, Mohamed Elkadeem, Stefan Hörmann, Gerhard Rigoll proposed this paper. In this paper ,they have used resnet50 with arcFace model as a pretrained model. Resnet is the encoder which extracts image features and trains with vocabulary built using the training captions data. ArcFace is also called as additive Angular Margin Loss is a loss function used in face recognition tasks. The author proposed a novel fine-tuning strategy with an octuplet loss function for existing models to boost their robustness against varying image resolutions. The octuplet loss is made up of the four triplet losses.

[2] CROSS-RESOLUTION LEARNING FOR FACE RECOGNITION by Fabio Valerio Massolia, Giuseppe Amatoa, Fabrizio Falchi proposed this paper. In this paper, they have proposed a training approach in order to improve the robustness of cross resolution up to a certain level, deep representations. They have used the images resolution from 8 px to 256 px with a same frequency. They have used various datsets such as LFW, IJB-B, IJB-C, QMUL-Survface and TinyFace.

[3] IMAGE RESOLUTION SUSCEPTIBILITY OF FACE RECOGNITION MODELS by Stefan Hörman, Martin konche proposed this paper they have analyze the impact of different image resolutions on face verification performance using a state-of-the art approach. They have proposed two intuitive methods to learn scale-invariant features directly. 1) BT describes training our network with batches containing LR and HR images in the same ratio. 2) ST is a siamese network structure constructed from a state-of-the-art network. In this paper, they trained model with several resolutions at once. So, single model can be applied to arbitrary image scales. They have used five datasets for same purpose.

## III. Keywords

• Triplet Loss:

Triplet-based learning helps extract more discriminative face embeddings. The goal of the triplet loss is to make sure that:

Two examples with the same label have their embeddings close together in the embedding space. Two examples with different labels have their embeddings far away. Minimizes the distance between anchor and positive having same identity. Maximizes the distance between anchor and negative having different identity.

• PyTorch :

PyTorch is a Python package that provides two high-level features: Tensor computation (like NumPy) with strong GPU acceleration Deep neural networks built on a tape-based auto grad system.

• OpenCV:

Real-time computer vision is the main emphasis of the OpenCV toolkit of programming languages. It was initially created by Intel and then backed by Willow Garage and Itseez. The Apache 2 License for Open-Source Software makes the library cross-platform and freely usable.

• Retine Face:

Retine Face performs three different face localization tasks together 1. Face detection 2. 2D face alignment 3. 3D face reconstruction

All the three targets are solved keeping in mind only one common target that all the points regressed for the above three tasks should lie on the image plane.

• 3D Face Reconstruction

For creating a 3D face from the 2D image, they are using a predefined triangular face with N vertices as shown.The vertices shares the same semantic meaning across different faces and with the fixed triangular topology.And ach face pixel can be indexed by barycentric coordinates and the triangle index making pixel wise correspondence with the 3D face.

• Multi-Level Face Localisation The loss function has 4 parts:

a) SoftMax loss for binary classes (face/ not face), where, p is the predicted probability that anchor i is face and p* is ground truth.

b) Regression loss of bounding box.

c) Regression loss of five landmarks

d) Regression loss of 3D points as discussed above.

• DATASET

Training and Results DeepFace is trained and experimented on the following three datasets

SFC dataset:

This is the dataset generated by Facebook itself. It contains nearly 4.4 million images of 4030 peoples each having 800 to 1200 face images The model is trained on three subsets of dataset 1.5k people (1.5 M images), 3k people (3.3 M images) and 4k people (4.4 M images). The classification error rate on these subsets are 7%, 7.2% and 8.7% respectively. YTF dataset:

It contains 3425 videos of 1595 celebrities (a subset of celebrities from LFW). These videos are divided into 5000 video pairs of 10 splits and used to evaluate performance on video level face verification. DeepFace-ensemble reach accuracy of 91.4% accuracy

## IV. Application

a) For Forensic applications where low resolution image has to be matched with high resolution image

b) Used for surveillance systems applications

c) Multimedia applications, such as digital entertainments usually exhibit dramatic non uniform illumination, occlusions, low-resolution, and pose/expression variations

d) Airport security

e) Suspect Identification specifically used by Police forces

## V. Limitations

Poor Image Quality :- The performance of face recognition algorithms is affected by image quality. The quality of the scanned video is poor compared to digital cameras. Even HD video is usually 720p, but can go up to 1080p. These images correspond to 2MP and 0.9MP, but lower-end cameras can shoot 15MP.

Small Image Sizes:- When face detection detects a face in a photo or still image of a video recording, the success of face detection depends on its relative position relative to the full size tag of the image. Due to the already small image size and the distance between the target and the camera, face detection is only 100 to 200 pixels wide. Also, scanning images of different faces takes a lot of processing power. To reduce the error during detection and speed up image processing, most algorithms allow faces of different sizes to be selected.

Different Face Angles:- The angle of the target's face has a great influence on recognition. Generally, multiple angles are used when recording faces in face recognition software. The algorithm's ability to generate facial patterns is affected by visual cues other than facial expressions. The rating of a match increases with accuracy and image resolution.

## VI. Conclusion

In this work, we analyze the impact of different image resolutions on face verification performance using a state-of-the art approach. The distances between extracted features are deeply analyzed. We can avoid the problems caused by the cross resolutions. We can propose a fine-tuning strategy for existing models to boost their robustness against varying image resolutions.

Thus, the proposed system will be helpful in increasing the accuracy of the cross-resolution images in which one is low resolution and other is high resolution. This proposed system is based on the existing models so we can avoid costly pre-training of model.

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