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Face Recognition Using Facenet Deep Learning Network for Attendance System

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ABSTRACT

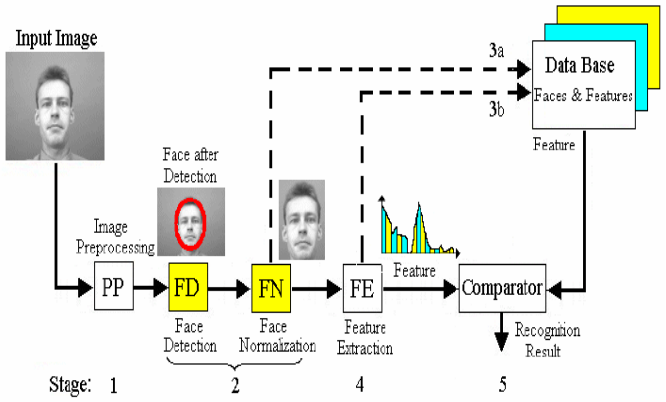
Face recognition that is technology used for recognizing human faces based on certain patterns and re-detect faces in various conditions. Face recognition is currently becoming popular to be applied in various ways, especially in security systems. Various methods of face recognition have been proposed in researches and increased accuracy is the main goal in the development of face recognition methods. FaceNet is one of the new methods in face recognition technology. This method is based on a deep convolutional network and triplet loss training to carry out training data, but the training process requires complex computing and a long time. By integrating the Tensorflow learning machine and pre-trained model, the training time needed is much shorter. This research aims to conduct surveys, test performance, and compare the accuracy of the results of recognizing the face of the FaceNet method with various other methods that have been developed previously. Implementation of the FaceNet method in research using two types of pre-trained models, namely CASIA-WebFace and VGGFace2, and tested on various data sets of standard face images that have been widely used before. From the results of this research experiment, FaceNet showed excellent results and was superior to other methods. By using VGGFace2 pre-trained models, FaceNet is able to touch 100% accuracy on YALE, JAFFE, AT & T datasets, Essex faces95, Essex grimace, 99.375% for Essex faces94 dataset and the worst 77.67% for the faces96 dataset.

Keywords — Face Recognition, Face Detection, FaceNet, Deep Convolutional Network, TensorFlow, Deep Learning

I. INTRODUCTION

Face recognition is one branch of computer science is an ability to recognize or identify the person's identity by analyzing the pattern-based facial contours of human faces. The development of face recognition methods in the last two decades shows very rapid progress. Initially, the method was running very slowly with the results of poor accuracy so that it cannot be applied daily life until now it can be applied in real-time by producing excellent accuracy. Currently, face recognition is used as a technology to

provide multiple security in various practices like verification of identity, access authority, observation, to replace passwords and identity cards that are no longer safe. The use of face recognition has the benefit of verifying personal data because inhuman faces things like irises, retinas, and faces are very unique to each other.



Face Recognition has many methods in its application today. For Ex: FaceNet, OpenFace, etc. FaceNet is one of the uses of face recognition based on Deep Learning. That is a one-shot learning method using Euclidean space to calculate the similarity distance for each face. FaceNet is a fairly new method, introduced by Google researches in 2015, using Deep Convolutional Network method. In the early 1990s, traditional face recognition systems were not stable and still did not appear deep learning and had several errors in real time applications. Nowadays, deep learning appears and it is especially good for recognition and detection. Deep learning acts like a human brain, learning by itself. In deep neural network architecture, when we create a neural network, the more the hidden layers (neurons), the better the accuracy. In this paper, FaceNet is used for extracting features from faces. Support vector machine is used for classification. To train the model, 'triplet loss' is a loss function. The purpose of the system is to easily know which students are in the classroom in a short time by implementing an automated attendance management system by using face recognition techniques and to save time consuming for taking attendance. The main purpose is to develop a reliable system by using deep learning. The system will record the attendance of the student automatically by matching from the training data-set.

II. METHODOLOGY

FaceNet

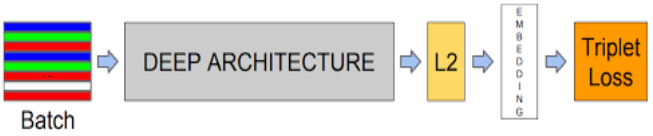
FaceNet was built by Google researchers using a Deep Convolutional Neural Network (DCNN) that maps images of a person's face into Euclidean spaces (collections of geometrical points) which are also called embedding.

Embedding is obtained from the level of similarity and differences in faces, so that if the face has a similarity the value will get closer, and if the face is different the value will get farther.

FaceNet is a method that uses deep convolutional networks to optimize its embedding, compared to using intermediate bottleneck layers as a test of previous deep learning approaches. This method is called one-shot learning. In more detail, this method can use a small sample of face images to produce the initial model, and when there are new models, the initial model can be used without retraining. FaceNet directly trains the face using the Euclidean space where the distance consists of similarities between facial models. When the results of similarities between face models are obtained, it will be easy to carry out face recognition and classification using FaceNet attached become feature vectors.

In the training process, FaceNet applies triplets by matching face to face with the online novel triplet mining method. Of course, this triplet consists of a collection of anchor images, where each image consists of positive and negative images. Fig. 1 shows the structural model used in FaceNet. FaceNet consists of batch layers as input and deep architecture which is deep CNN followed by L2 normalization, that become the result of face embedding FaceNet

also pursued by the triplet loss when the training process.



Triplet loss training methods have three main elements namely anchor, positive and negative. This triplet loss works by minimizing the distance between anchors positively and maximizing the distance between anchors negatively. Where this positive has the same identity as the anchor and negative has a different identity from the anchor.

FaceNet trains its output directly into concise 128-dimensional embedding by apply triplet based loss method depend on LMNN. It formed by two thumbnails of compared faces and thumbnails that do not match and the loss aim to distinguish between positive and negative pairs using a range of limit. Thumbnails were cut tightly on the face field, it didn't need 2D or 3D adjustment, apart from the ratio and translation implemented.

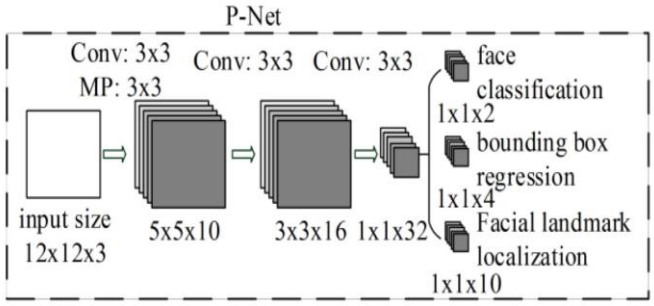
Preprocessing

At the preprocessing stage, three processes were carried out, namely, detection, resizing, and cropping faces using the library's help from Multi-Task Cascaded Convolutional Neural (MTCNN). Detection was used to determine the position of the face in a given image which was then realized in the form of a bounding box. Then implemented the cropping based on the bounding box. After obtaining a face image would be scaled (resize) according to the input size of the model. The MTCNN algorithm works through the three neural networks (P-Net, R-Net, and O-Net) connected to a single cascading neural network that is unique to each one of them.

The first neural network, P-Net, is known as the proposal network. It proposes the candidate image inputs for face detection and recognition and as well creates multiple copies of the proposed images.

The second neural network, R-Net, is known as the refine network. It feeds on the proposed image inputs from P-Net and refines by filtering the false candidate inputs from the true candidates.

The third and last neural network, O-Net, does the rest of the job. It concludes the operation by finding five facial landmarks among the candidate image inputs. A facial landmark contains key features of the human face.



Tensorflow

Using TensorFlow to build face recognition and detection models might require effort, but it is worth it in the end. As mentioned, TensorFlow is the most used Deep Learning framework and it has pre-trained models that easily help with image classification. In most cases, to generate a model means the classification of the images only needs to provide a similar image which is the positive image. The image is then trained and retrained through a process known as anchoring or Transfer Learning. Years back, finding that model for training and retraining was difficult. Now, TensorFlow has simplified the process. Thanks to its huge open-source community, no one has to go through the task of generating a model once another developer from the other end of the world had done it for all to use.

Classification

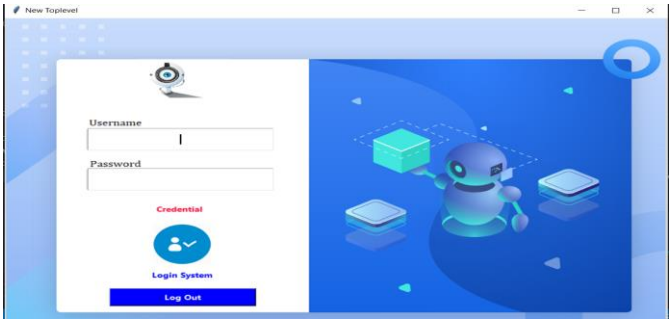
Face recognition classification in this system uses SVM because it has good performance and is widely used in face recognition . SVM works by giving dividing boundaries to 2 adjacent classes. Margin is the closest point between Hyperplane and the closest

point of each class which is then called the Support Vector Machine Linear Support Vector Machine (SVM) is very effective and widely used when separating face embedding vectors.

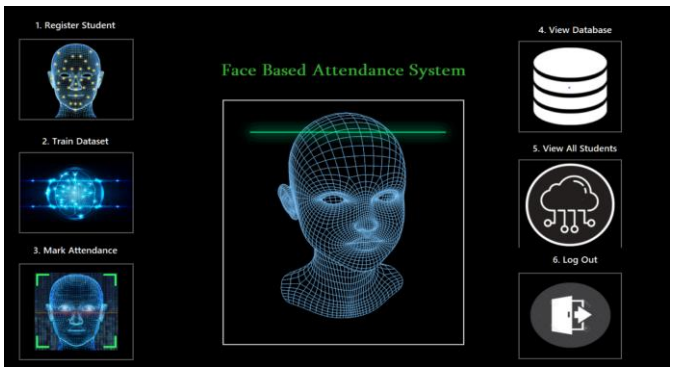
By adjusting linear SVM to training data and setting 'kernel' attribute to 'linear'. In making predictions, will use the probability used to set it to be true. In classifying the data is divided into 80% training data and 20% test data. The two groups of data will be processed by training and save the SVM classification model in a file. Classification performance will be evaluated using a confusion matrix.

III. PROPOSED SYSTEM

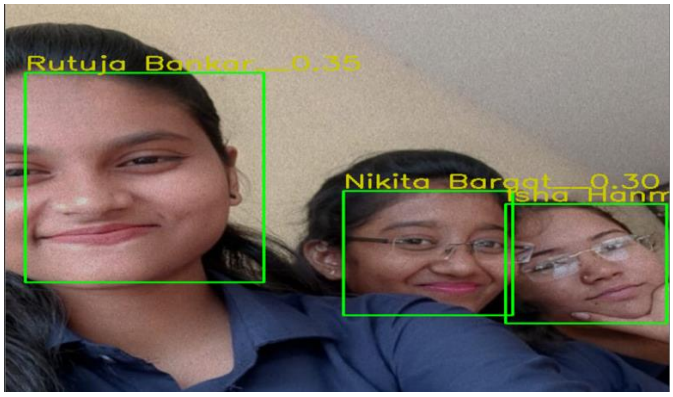
The purpose of this work is to implement a system that can automatically mark the attendance of the students present in a classroom without the involvement of the teacher. Here we are introducing an automatic attendance marking system by face recognition using FaceNet. The ultimate objective of the system is to improve and organize the class attendance system and to decrease the number of errors occurred in the manual process and to provide attendance reports periodically For this proposed system, initially we have to collect the required dataset from the students, which the photos of the students and store them in the database. The students must provide pictures based on the sample pictures. The sample should have ten images from different angles. These ten images of each student will be stored in the database with their name/roll no as the file name. These 10 images will be stored in a folder with their name/roll no. The operations like blurring, contrast/brightness, rotation will be applied for each of the images. From the above mentioned ten images eight images will be taken for the training purpose and two images will be taken for the testing purpose. The system can be divided into two phases testing phase and prediction phase.



After collecting the required dataset, we pass it for the face detection purpose. For face detection, here we are using MTCNN (Multi-Task Convolutional Neural Network). MTCNN does both face detection and face alignment and the process consists of three stages of convolutional networks that are able to recognize faces and landmark location such as eyes, nose and mouth. The MTCNN will detect the faces from the given images and extract the features from the faces and convert them into unique arrays. Then those extracted features will be stored in separate files for each students with their name as file name. Then FaceNet model should be loaded into the system and it will be trained with the extracted features of each students. Get two images from each student's dataset for testing and test those images with the FaceNet model. The FaceNet has an accuracy of about 99.63 %, which makes this system more accurate. FaceNet takes an image of the person's face as input and outputs a vector of 128 numbers which represent the most important features of a face which is called as an embedding. The FaceNet transforms the face image into 128-dimensional vectors and place it in the Euclidean space and the model thus created is trained for triplet loss to capture the similarities and differences on the image dataset provided. Finally the SVM (Support Vector Machine Classifier) algorithm is used for the classification of each trained model.



A camera will be placed in the classroom, which will capture an image that containing all the students that present in the classroom, in a regular interval. From the captured image, faces of each student will be extracted and then they are encoded with the FaceNet model. The result will be passed to the trained model for comparison and determining the corresponding student. Then we get the names/roll.no of the corresponding students as the output for marking attendance, which will help us to mark the attendance of the students. The recorded attendance will be stored in the database, which the teacher can later access by logging in through the website which will be available asexcel sheet.



IV. CONCLUSION

Face Recognition based Attendance System Using FaceNet and MTCNN was successfully implemented. As a result of this standalone system, the person in the dataset was detected and an excel sheet of the current students was created with an accuracy of Thus, it proved to be a more time-saving and secure system than traditional attendance systems.

We can extend the work in order to implement a fully-featured attendance system using facial recognition and marking the attendance in order to provide a more real-time analysis of attendance data.

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