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Face Recognition with OpenCV Python and Deep Learning in Artificial Intelligent

Research Paper

Intrusion Detection System using Face Recognition

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Abstract: The ability to automatically recognize human faces based on dynamic facial images is important in security, surveillance and the health/independent living domains. Specific applications include access control to secure environments, identification of individuals at a particular place and intruder detection. This research proposes a real-time system for surveillance using cameras. The process is broken into two steps: (1) face detection and (2) face recognition to identify particular persons. For the first step, the system tracks and selects the faces of the detected persons. An efficient recognition algorithm is then used to recognize detected faces with a known database. The proposed approach exploits the Viola-Jones method for face detection, the Kanade-Lucas-Tomasi algorithm as a feature tracker and Principal Component Analysis (PCA) for face recognition. This system can be implemented at different restricted areas, such as at the office or house of a suspicious person or at the entrance of a sensitive installation. The system works almost perfectly under reasonable lighting conditions and image depths.

I. INTRODUCTION

A face recognition system is one of the biometric information processes, it is applicability is easier and working range is larger than others, i.e.; fingerprint, iris scanning, signature, etc. The system uses a combination of techniques in two topics; face detection and recognition. The face detection is performed on live acquired images without any application field in mind.

The system is also capable of detecting and recognizing multiple faces in live acquired video. This project is aimed to design an intelligent intrusion detection system that will be able to recognize and identify any person and give alarm if the face is not recognized.

Reading human facial expressions can help us in our day-to-day activities such as security issues, gaming technology, marketing, and advertising and the expert system.

Face recognition technology can be useful towards providing a security features for everyday appliances, products, and even our living space. It is found that most surveillance facial recognition systems only automatically check every person against a database of known suspects. This makes it hard for securities to catch someone who has the intentions of stealing or about to do any forbidden act.

Today's institutions are facing major security issues; consequently, they need several specially trained personnel to attain the desired security. These personnel, as human beings, make mistakes that might affect the level of security. A proposed solution to the aforementioned matter is a Face Recognition Security System, which can detect intruders to restricted or high-security areas, and help in minimizing human error. This system is composed of two parts: hardware part and software part. The hardware part consists of a camera, while the software part consists of face-detection and face-recognition algorithms software. When a person enters to the zone in question, a series of snapshots are taken by the camera and sent to the software to be analyzed and compared with an existing database of trusted registered people. An alarm goes on if the user is not recognized.

II. RELATED WORK

Face detection is one of the most heavily studied topics in computer vision literature. The Viola-Jones face detection algorithm is one of the most popular and simple algorithms used in this field. Its feature-based technique is relatively robust to position variations, interested reader may read for details. In principle, feature-based schemes can be made invariant to size, orientation and/or lighting. Other benefits of these schemes include the compactness of representation of the face images and high-speed matching. The problem of these approaches is the difficulty of automatic feature detection and that the implementer of any of these techniques has to make arbitrary decisions about which features are important. The features of the Viola-Jones algorithm were further extended, leading to many other face detection methods. A similar approach was proposed in, where instead of computing Haar-like features, individual pixels are compared. The Viola-Jones method, which considers only 4 types of horizontal/vertical features, was later extended by Lienhart and Maydt by introducing rotated features. In the subsequent years, many variations of the Haar-like features were proposed. Interested readers may read for more information. Face recognition is another well-known topic of computer vision and pattern recognition that has been extensively studied over the past few decades. One of the most well-known face recognition methods for face classification is the early work of Turk and Pentland , which is based on the notion of eigenfaces. It was previously shown that any face image can be represented as a linear combination of pictures (called eigenfaces) and their coefficients. This method is based on Principal Component Analysis (PCA), with the eigenfaces serving as the principal components of the initial training set of face images. The face space generated by the PCA is one where the variance of all the samples is minimized. By projecting the faces in a space where the variance of the samples within one class (same individual) is minimized and, at the same time, the variance of the samples between classes (different individuals) is maximized; one can achieve better classification results. This is the idea behind the Fisher-faces method. The basis vectors for such a sub-space can be generated by Linear Discriminant Analysis (LDA). Real-time recognition of faces is needed for surveillance to ensure security. It involves real-time recognition of faces from a sequence of images captured by a video camera. Much research has been directed to this area. In most cases, recognition has been performed through choosing a few good frames and then applying a suitable recognition technique for intensity images to those frames in order to identify the individual. A two-layer Radial Basis Function network and Difference of Gaussian (DoG) filtering as well as Gabor wavelets were proposed and used by Howell and Buxton for learning/training and to analyze the feature representation, respectively, while other schemes, such as combined motion and model based face tracking, have been utilized for face detection and tracking. A skin color modeling system was proposed by Campos et al to detect the face. GWN was then utilized to detect prominent facial points such as the eyes, nose, and mouth and to track those features. Here, the eigenfeatures of each individual frame are then extracted and all the eigenfeatures are combined by a feature selection algorithm. Later, the best eigenfeatures are selected to form the feature space. A couple of classifiers have been applied to identify individual persons in the frame. Finally, a super classifier performs the final classification for the entire video sequence. The recognition rate has been found to be high, at nearly 98 percent. Some approaches have utilized a video-to video paradigm that collects information from a sequence of frames from a video segment and then combines and associates it with an

individual face. This approach involves a temporal analysis of the video sequence and a condensing of the tracking and recognition problems, but these operations are a matter of ongoing research, as the reported experiments were performed without any real variations in orientation and facial expressions. It is also important to mention here that several other schemes have incorporated information from other modalities to recognize faces from images acquired from video clips. System makes use of stereo information, with high recognition accuracy (of 90%) reported. More recently, many other methods and techniques have been developed and introduced for face recognition from video cameras.

III. METHODOLOGY

i. Image Processing

For detection and recognition of specific characters in complicated images, the project starts with installing OpenCv2 in python environment. First, source image path is added to the process. Image is been transformed from RGB format image value from 0 -255 to Greyscale value by obtaining the average channels color and making each channel equals to the average with the function ***cv2.COLOR_BGR2GRAY***, formula of ***x=(R+G+B)/3. RGB*** value have to be normalized where

X=(R * 0.229 + G * 0.587 + B * 0.114)

After image been convert to greyscale, Template Matching method is been applied with the function **matchedIdxs = [i for (i, b) in enumerate(matches) if b] counts = {}**where the variable 'matchedIdxs' is defined by dataset image to be found. This function will compare the template image over the source image under the template image and several comparison methods are implemented. Result return with the value of each pixel hold in source image, then been compare to template image to determine the neighbor of the pixel match. Once get results, function ***cv2.minMaxLoc(result)*** is used to determine the maximum and minimum values in pixel. The region of the template image are determined.

To show the matching region, bounding box are created. Because function are ***rgb = imutils.resize(frame, width=400)*** method, so we take the maximum where ***(left, top), (right, bottom), (0, 255, 0), 2)*** for making sure the box is in the matching region. To set the box size, function ***cv2.rectangle()*** is used where the box output is rectangle and match the matching template.

The function ***cv2.imshow()*** is used to output the final result and show in RGB image together with matching box.

ii. Face Recognition

Face-recognition library are installed in the python environment along with OpenCv2. These library are able to do real-time recognition in live. This task is conducted by using live method which require webcam to capture face. ***cv2.VideoCapture(0)*** function are used for reference to default webcam. To recognize the face in real-time, deep learning had to be done. Network have to learn to be able recognize the face real-time by using provided dataset. In this project function ***face_recognition.load_image_file()*** are used to provide dataset for network to learn. In deep learning, dlib face-recognition, the output vector is 128-dimension real-valued numbers that are used to quantify the face. The training method is done using "triplet" which is already in face-recognition library. Function ***face_recognition.face_encoding()[]*** from cv2 enable network to perform deep learning and training. If there is more than 1 face to recognize, the function must be written based on the numbers of face to recognize to enable the network to learn. Array for known face encoding and the names is been created.

While the face appear on live cam is true, a single frame from video will be capture and read to identified and detect, ret,frame = video_capture.read() . From the image captured, the image is been converted from BGR color format where OpenCV uses to RGB color format which face recognition uses rgb_frame=frame[:; :; ::-1] . After been converted to rgb frame, all the face appear in frame of video will be identified, face_recognition.face_location(),face_recognition.face_encodings().

Each frame of the video will be looped continuously frame by frame which causes the results output video to be slow because of the limitation of the performance. Next it will compare the source dataset with the video frame and check if it's match the known face by using function ***face_recognition.compare_faces()*** . Tolerance will be set for the distance between faces to consider whether it is matches. Lower is more strict. If unrecognized face, it will refer as 'Intruder' . After matches found in the known face, the first one will be used. Function ***cv2.rectangle()*** been declared for bounding box, purpose for draw box around matches face. Label with known face name will be add below the face.

Finally, the results has been displayed.

IV. CONCLUSION

In conclusion, the problem of the project have been solve and the goal had been achieved yet the result are still not accurate due to limitation of hardware performance. Image processing task successfully found in the character in complicated image. Face recognition in live video are successfully implemented. Although this face recognition project has been successfully implemented but I have not satisfied with the project yet because it has to be enhanced by other features to make it works smoothly.

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