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TRACKING UNAUTHORIZED ACCESS USING MACHINE LEARNING FOR FACE RECOGNITION

P.N.B. Swamy, A. Sathi Babu, V. Rahul, SK. Arfath Hussain, V. Durga Prasad, T. Bhavinash
Department of ECE, NRI Institute of Technology, JNTUK, India : rahulvaliveti212@gmail.com

Abstract:
In the last two decades there has been obtained tremendous improvements in the field of artificial intelligence (AI) especially in the sector of face/facial recognition (FR). Over the years, the world obtained remarkable progress in the technology that enhanced the face detection techniques use on common PCs and smartphones. Moreover, the steadily progress of programming languages, libraries, frameworks, and tools combined with the great passion of developers and researchers worldwide contribute substantially to opensource AI materials that produced machine learning (ML) algorithms available to any scholar with the will to build the software of tomorrow. The study aims to analyse the specialized literature starting from the first prototype delivered by Cambridge University until the most recent discoveries in FR. The purpose is to identify the most proficient algorithms, and the existing gap in the specialized literature. The research builds a FR application based on simplicity and efficiency of code that facilitates a person's face detection using a real time photo and validate the access by querying a given database. The paper brings contribution to the field throughout the literature review analysis as well as by the customized code in Phyton, using ML with Principal Component Analysis (PCA), AdaBoost and MySQL for a myriad of application's development in a variety of domains.

Keywords: *Detection, Image Processing, Deep Learning, Unauthorised, CNN algorithm.*

1.INTRODUCTION

Individual survival in a socially complex environment is heavily reliant on the capacity to understand visual information about a person's age, gender, ethnicity, identity, and emotional state based on that person's face. Despite a range of challenging settings (numerous facial expressions and postures, alterations in light and appearance), human beings can execute face identification with astonishing consistency without conscious effort. FR problem is considered one of the most proficient and profitable application of ML and computer vision. Although FR research utilizing automated or semi-automatic algorithms began in the 1960s, has gotten considerable interest in the last 20 years. FR algorithms have a wide range of conceivable applications, which is one reason for its current rising popularity. Another factor is the widespread availability of inexpensive hardware, including digital cameras and video cameras, which has made capturing high-quality, high-resolution photographs in a considerably facile manner. Despite the increased interest, existing state-of-the-art FR algorithms function effectively when facial photographs are taken in consistent and controlled situations.

As a result, FR is a less invasive and perhaps more successful identifying tool. With the advancement of information technology, the desire for an accurate personal identification system based on detecting biological traits is rising, rather than traditional systems that employ ID cards or PINs. The face is the most recognized and identifiable of all bodily features, therefore utilizing it for identification reduces the necessity for direct contact, as well as any psychological or physical opposition, such as that faced while trying to acquire fingerprints.

Furthermore, the research aims to build a FR application that facilitates a person's face detection using a photo and validate access by querying a given database. The applicability is immense as it can be integrated in any domain that requires facial identification. This article's guiding concepts are simplicity and efficiency. Among others, the research contributes through a clear and succinct guideline on how to build a FR system. It also employs generally available and free development technologies, while the hardware requirements are minimal. This is making it an ideal alternative for

academics and/or developers interested in this 2 of 13 area. Thus, the solution brings a less costly, efficient, and secure way of authorizing employees' access.

2.LITERATURE REVIEW

There is a significant amount of research in the area of surveillance using image processing and machine learning. Many researchers have proposed different approaches to improve safety and security. One approach is to use computer vision techniques, such as image processing and object detection algorithms, to detect the unknown persons and unauthorised persons. Yao L S, Xu G M, Zhap F authors of "Facial Expression Recognition Based on CNN Local Feature Fusion", they used the transition of facial expression recognition (FER) from laboratory-controlled to challenging in-the-wild conditions and the recent success of deep learning techniques in various fields, deep neural networks have increasingly been leveraged to learn discriminative representations for automatic FER. Zhang Chen researched on some key technologies of "facial micro-expression recognition" the author used FER. It comprehensively discusses three significant challenges in the unconstrained real-world environments, such as illumination variation, head pose, and subject-dependence, which may not be resolved by only analysing images/videos in the FER system. We focus on those sensors that may provide extra information and help the FER systems to detect emotion in both static images and video sequences. In expression "Recognition algorithm for constructing parallel CNN" by Xu Linlin, Zhang Shumei, Zhao Junli

3.METHODOLOGY

3.1 PROBLEM STATEMENT

To overcome the limitations of general surveillance techniques, this project proposes a new approach that uses machine learning and image processing techniques to increase the security in the restricted area.

The proposed system aims to improve the safety and alert the security members by providing dataset of required members and alerting the security by siren and Email message.

3.2 TRACKING UNAUTHORIZED ACCESS

3.2.1 Pre-processing:

Pre-processing is an important step in the image processing pipeline. It is the process of preparing the raw image data for further analysis or machine learning. The goal of pre-processing is to enhance the quality of the image and make it easier to extract meaningful information from it.

Fig.1. Sample Image

In the pre-processing the dataset is created with the trained images of 200 in a folder. The sample image represented few images in the folder. The capturing of these images is to train the model to compare the live feed image with trained image.

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3.2.2 Face Recognition

We used Local Binary Patterns Histograms (LBPH**)** algorithm for creating a face recognition model from Open CV library. LBPH algorithm is one of the approaches of FR algorithm. The method that we use to create face recognition is:

'cv2.face.LBPHFaceRecognizer_create()'

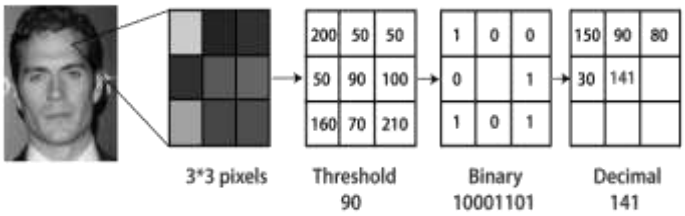

Fig.2. LBPH algorithm

This method returns an instance of the LBPHFaceRecognizer class, which can used to train a face recognition model on asset of images containing faces. The algorithm works by extracting local binary patterns from the input images that creates histogram of patterns for each face. The histograms are then used as features to train a classifier that can distinguish between different faces. While applying this method we call 'train()' and 'predict()' to train and use the face recognition model.

PCA (Principal Component Analysis) is also used in the project for data reduction and extraction of features in statistical pattern recognition and signal processing. It also used for reducing the dimensionality of image data while preserving the most important features.

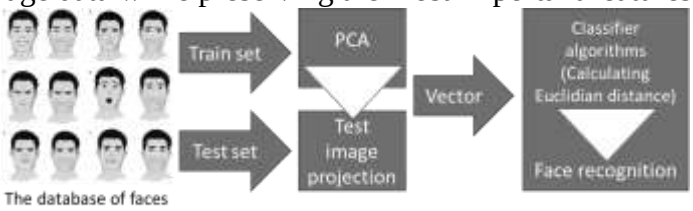

Fig.3. PCA approach for FR development

A 2-D face image of size N*N can also be thought of as a one-dimensional vector of dimension N2. A picture ensemble corresponds to a set of points in this vast space. Face images, because of their pretty much identical arrangement, will not be distributed randomly in this massive image space and can therefore be characterized by a relatively low dimensional subspace. The fundamental concept behind the PCA is to locate the vectors that effectively account for the distribution of face pictures across the full image space. These vectors constitute the "facial space", and it is the subspace of pictures of faces.

3.2.3 Deep learning:

Deep learning is used to detect human faces by identifying the features of a human face from images or live streams.

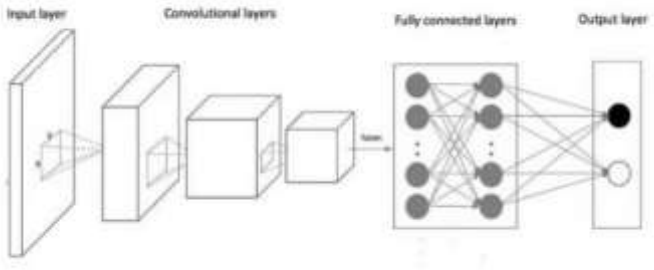

Fig.4. CNN architecture Tracking Unauthorized Access

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A convolutional neural network (CNN) is a popular type of deep learning algorithm that have shown great success in image recognition tasks, including face recognition. To perform face recognition using CNN, first we need to train a CNN model using large dataset of images of faces. During the training the CNN learns to identify the unique features like shape of their eyes, nose, and mouth. After completion of the training, it can be used to recognise faces in new images by extracting features from the image and comparing them to the features learned during training.

3.3 FLOW CHART

The flow chart for the implementation of a tracking unauthorised access using image processing and machine learning is explained in the below figure

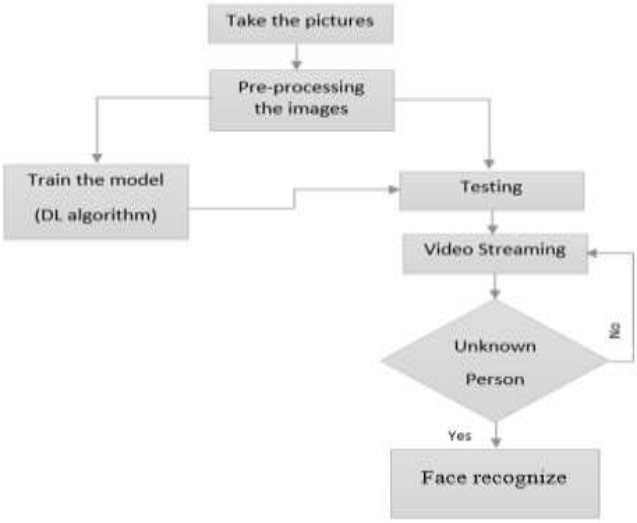

Fig.5. Flow Chart of Developed Project

The flow chart outlines the process of collecting the pictures of the person for the training of the person to be an authorised person. The images are first pre-processed and then send to the training. Then the person is authorised and stored in the dataset along with the name. If the person entered into the restricted area then the CCTV with live feed captures the images and compare the live feed images with the trained images. If the person is authorised then an green box with name is displayed or else a red box with unknown is displayed and alarm is raised with Email sent to the security chief and the area head.

The project works in a loop that it works after the person left the recognition area in the camera and continues to feed the data for the next persons to be entered into the restricted area. This can be used in the exam cell in the colleges and in the record rooms in police stations also.

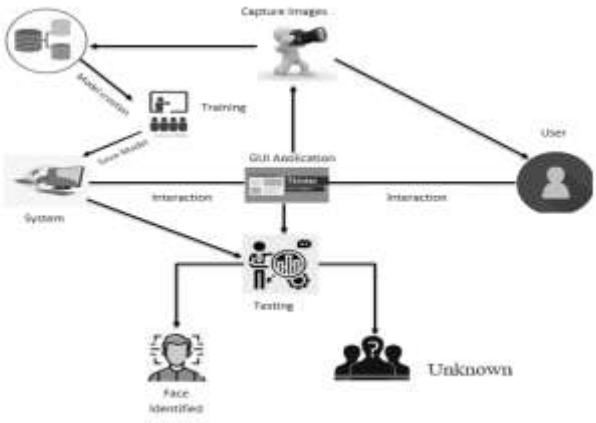

Fig.6. Architecture of Face Recognition

The architecture provides the complete detailing about the face recognition where the user details are trained directly by capturing images or by GUI Application in middle. Those images are stored in the database.

3.4 TRAINING LOSS VS ACCURACY

In tracking unauthorised access, a training loss vs accuracy graph can be used to monitor the restricted area security for only authorised persons. The horizontal axis represents the trained images and the vertical images represents the accuracy of the output. For less trained images the accuracy is low as the trained images increases then the accuracy increases along with decreasing in the loss. So, the final output will be more accurate when the trained images are more.

The training loss is the measure of how well the model is able to minimize the difference between the predicted output and the true output. It is often used as a proxy for the model's ability to learn the underlying patterns in the data.

Accuracy measures the percentage of correctly identified faces in the training set. It is calculated by comparing the predicted labels to the true labels and calculating the percentage of correct predictions.

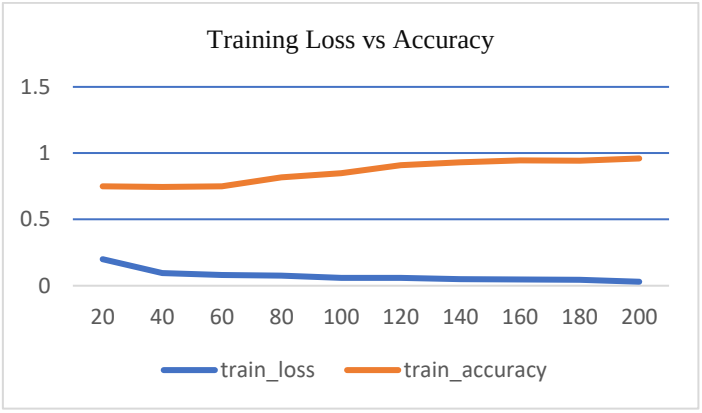

Fig.7. Loss vs Accuracy

Overall, both the training loss and accuracy are important in face recognition that can help to evaluate the performance of a model and guide the training process.

4. RESULT

A dataset of 200 images is captured and trained for storing the data of authorised person. To train an image first we capture 200 images and only the security chief can allow the person to train and store the data in the dataset. The accuracy of capturing the face is high and the project is highly useful in dust, fog and rainy conditions.

Fig.8. Authorized Person

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In the above result the person is authorised person. As his face in the live feed is compared with the trained dataset. So, his name is displayed and no siren will be alarmed. He can freely enter into the restricted area. Until an unauthorised person entered into the room.

Fig.9. Unauthorized Person

Here, two persons are recognised by the camera and one among them is authorised and another person is unauthorised. The person who is authorised is displayed with name and the unauthorised person is displayed as unknown then the siren is raised because the unauthorised person entered along with the authorised person.

5.CONCLUSION

In conclusion, face recognition is a powerful technology that many applications in various fields, such as security, surveillance, healthcare, and social media. With the advent of deep learning techniques particularly CNN and LBPH algorithm, face recognition has become more accurate and robust, enabling it to be used in many real-world scenarios. One of the advantages of deep learning models is their ability to automatically learn discriminative features from raw input data, which makes them suitable for face recognition tasks that involve large and complex datasets.

However, deep learning models also requires a large amount of training data and computational resources, which can be challenging is some cases.

Despite the challenges, face recognition using image processing and deep learning has already shown promising results and is expected to continue to advance rapidly in the coming years. Therefore, it is important to use face recognition technology responsibly, with appropriate regulations and guidelines in place to protect individual rights and prevent misuse. By doing so, we can harness the benefits of face recognition while minimizing its potential harms.

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