FACIAL RECOGNITION BASED SYSTEM FOR CERTIFICATE VERIFICATION USING DEEP LEARNING

kalaiselvi S[1], akalya N[2], aarthi V[3], chandrukumar S[4], vivekananda V[5]

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Abstract

A certificate is an official document issued by an organization to certain qualified individuals as proof that the individual has completed a particular apprenticeship, course, study, or program. However, in today's world, certificate fraud and identity theft are still on the rise in both public and private organizations. The traditional means of document verification is observational methods that observe documents and automatically accept certain actions or procedures based on signatures, stamps, seals, etc. However, these standards used to authenticate documents can be very easily replicated to commit fraud and has become a big problem.
Biometrics with biometric detection as fraud protection is therefore an exclusive and convenient way to link individuals to their digital identities, especially when used in unattended situations. Therefore, an electronic certificate generation and authentication system based on face recognition technology using DL has been proposed. We propose a new face detector, Deep Convolutional Neural Network. It is fast and can detect faces with large variations (especially small faces). This project enables face login with multifactor user authentication. The new system essentially uses facial acknowledgement as a form of liveliness detection, allowing users to access their credentials via a request and response module when trying to participate in a job interview or for other purposes. Each certificate has a unique hash key that any organization can use to verify the authenticity of the certificate through the portal. Quickly find out if a document is valid and check if any changes have been made with local and international registry checks. The advantage of this system is that there is less risk of students or users losing or destroying certificates, and certificate verification is very easy to perform.

Index Terms: Web application, CNN, Segmentation, Deep Learning, Feature Extraction, Face Classification.

[1]Assistant Professor, Master of Computer Applications, Karpagam College of Engineering, Coimbatore, India
[2, 3, 4, 5]PG Scholar, Master of Computer Applications, Karpagam College of Engineering, Coimbatore, India

Email: [1]kalaiselvi.s@kce.ac.in, [2]akal1672001@gmail.com, [3]aarthirajan2000@gmail.com, [4]chandrukumar2274@gmail.com, [5]v.vivekanandha26@gmail.com.

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1. Introduction

What is meant by "confirmation" in the context of a social company is the act of checking the veracity of data provided by clients. The verification and validation techniques used to confirm an individual's identification have their roots in the "paper transactions" era. Several investigations have been done to create copies for the purpose of certificate verification and approval in local governments.

G. Thomson [1] proposed a new idea called Deep Learning, his learning of new models. Deep learning is able to obtain good approximations of complex functions by incrementing the hidden layer, thus obtaining amazing face recognition results. It's a machine language that teaches computers what humans naturally do. For this article, we decided to use Deep learning. Researchers have recently looked into the possibility of deploying CCTV systems equipped with a deep learning technique, such as CNN, to detect fires or locate weapons. [2], [3], [4]. The subfield of machine learning known as "deep learning" [5] uses neural networks to solve AI-related challenges. Many neurons are used in Deep Neural Networks to represent the human brain's neocortex. Neural networks based on these cells are the backbone of deep learning models.

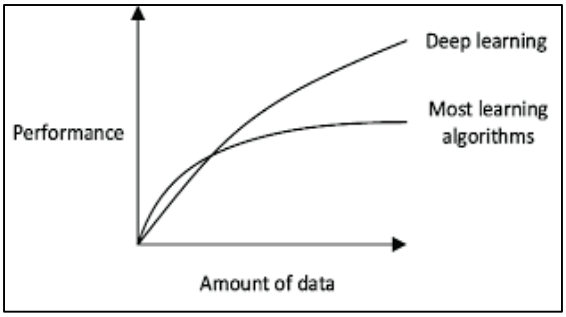

Fig.1 Comparison Graph on Deep Learning Algorithm

Deep learning makes use of a wide variety of neural network model types [6] - [8]. When it comes to the security of sensitive financial and other personal information, facial biometric systems are among the highest in importance. Access control systems in restricted locations, computers, airports, and surveillance systems are just some of the places it finds use [9], [10]. Businesses have started incorporating behavioural elements like gait, signature, and voice recognition into biometric systems in recent years [11], [12], [13]. Compared to other methods of biometric authentication, such as fingerprinting, Iris scanning, voice analysis, and vein scanning, face recognition is the most practical.

Face photographs are utilised in biometric identification processes that rely on facial recognition [14]. In order to determine who someone is, we need to look at their physical traits. Humans have an excellent ability to recognise each other upon first glance, however there is a limitation to the eye's ability to focus. Thus, scientists came up with a way to use computers to aid in the process of facial recognition. Automatically identifying and syncing human faces in still and moving media is the goal of face recognition [15].

Literature Review

The convolutional layer is responsible for performing the convolutional operations on the input data, and it does so by using filters. Filters can be thought of as matrices, with one serving as the basis for the others. Until the entire image has been scanned, the convolutional procedure proceeds as follows: the filter slides horizontally (at a certain step size), then moves vertically (at a different step size) for the following horizontal slide. The Feature map is a new matrix formed from the collection of filter outputs. A stride's width and height refer to its horizontal and vertical dimensions, respectively. The specific feature map count is a tuning parameter in the design of the related convolutional neural network.

The effectiveness of three distinct classifiers—SVM, KNN, CNN—was measured on the MNIST datasets by Norhidayu binti Abdul Hamid et al. [16]. On that platform, the multilayer perceptron's performance was poor since it was unable to correctly distinguish the digits 9 and 6, as it was locked in the local optimal rather than the global minimum. When compared to other classifiers, it was determined that deploying the model on the Keras platform would boost CNN's efficiency.

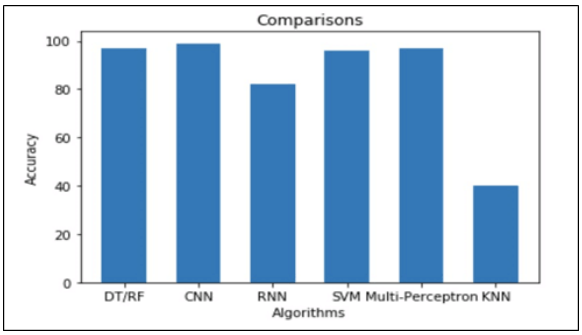

Fig. 2 Comparison Graph on CNN Accuracy Level

The face recognition method for id'ing a person through several experiments is presented by S. T. Gandhe [17]. The facial recognition features of this system are what allow it to authenticate users. Potential uses for this system include an identifying system, an access control system, and a document management system.

The template matching approach for facial recognition was proposed by Anil Kumar Sao et al. [18]. The pose issue in face recognition is addressed by this method. It all starts with an edge view of the faces. After a picture is processed, it is subjected to template matching. Edge detection methods reduce an image to a single dimension. Based on this score, a person is identified.

Using a convolutional neural network (CNN), Hu et al. [19] demonstrated an approach that enhanced facial recognition accuracy. CNN, which is functionally comparable to a Gated Two-stream Neural Network, was used to add an additional layer (GTNN). In this study, the authors developed a strong non linear sensor-based fusion framework for face recognition, one that makes use of low-rank Tensor optimization and a GTNN to improve the performance of both the Face Recognition They started by methodically researching and confirming the different facial recognition scenarios, including stance and lighting. The authors then used a neural network optimised Tensor fusion framework that was low-rank Tucker- decomposed. For the LFW dataset, the authors achieved 99.65% accuracy, and for CASIA NIR-VIS2.0, they achieved 99.94%. (Cross-Modality environment). Yet, the 45-degree posture angle yielded 100% accuracy.

Applications in areas like security, surveillance, and identity verification have helped boost facial recognition's profile in recent years. Lately, (CNNs) and other forms of deep learning have shown remarkable accuracy in facial recognition.

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Proposed Approach

A new automated system manages digital document identification, matching photos on ID papers with live faces. Data is stored in various nodes, and anyone wishing to access specific internal data must request that other nodes modify the data concurrently. As a result, this method is extremely dependable. This system is being created as a decentralized application, and a certificate system is being designed, with the data being trained using the CNN algorithm. Live face capture, rather than scans or digital document photos, is used to verify users, and the user's live face is compared to validated and trained faces in the Aadhar database. The user sends the necessary files to the server. A CNN is a neural network structure used in deep learning

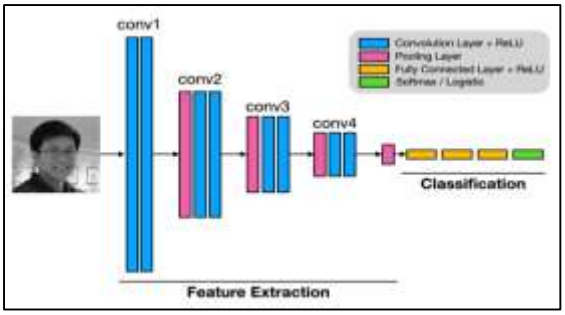

Fig. 3 Face Extraction

A pooling layer of the CNN is used to reduce the size of the plot and speed up computation as well as slightly robust some of the detected features.

CNN, image classification model can be alienated into parts. **Feature Extraction**: The aim of this section is to find image features. **Classification**:

The goal of this section is to categorise images using the various features extracted in the preceding section. For example, the eyes, nose, and brows distinguish a specific person's human face.

Procedures for this system:

A. Face Image Acquisition

Cameras should be placed throughout the company to capture pertinent video. The computer and camera conspire, and then the microphone is used.

1) Frame Extraction:

From the video feed, frames are extracted. A video must be broken down into a succession of images that are then processed. Individual implementations determine how quickly the movie must be split into frames. This means that approximately 20 to 30 frames captured and sent to the subsequent step.

B. Pre processing

Face image preprocessing is a method of preparing pictures for use in model training and implication. Here are the steps to take:

- Read Pictures
- RGB to gray scale adaptation
- Adjust image size

➢ Original size – (width,, height, sum of RGB)

➢ Resize

- Eliminate noise (noise reduction)

Flattens the image to eliminate unwelcome noise, we do this with a Gaussian Blur.

- Binarization

Image converts a grayscale image to black-and-white, significantly reducing the information of grey to 2: In black and white Image in binary form.

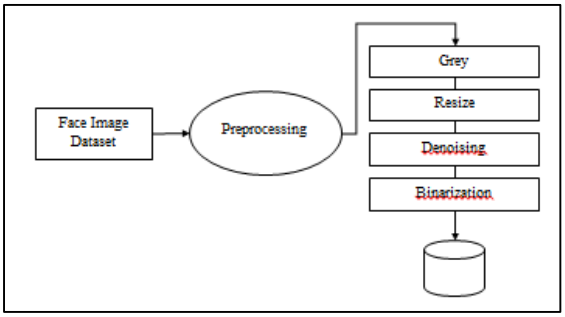

Fig. 4 Pre processing

C. Face Detection

Method for detecting and segmenting faces based on an enhanced Region Proposal network (RPN). RoI align faithfully maintains the precise special location when RPN is used to generate RoIs..

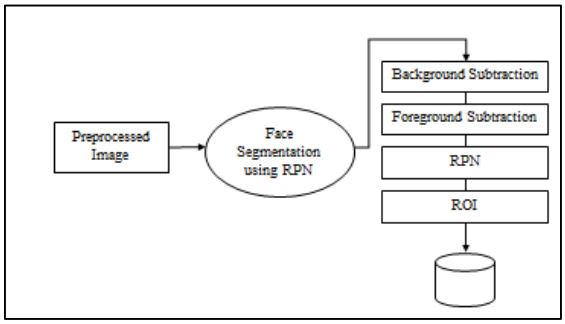

Fig. 5 Face Segmentation

1) Face image segmentation Region Growing (RG) system:

This segmentation technique examines neighboring pixels of an initial "Seed Point" and decides whether neighboring pixels should be additional to the area methods use only the "strength" constraint to look at neighbouring pixels. A level of intensity values is established, and neighbouring pixels that match this threshold are chosen for region growth.

2) RPN:

It operates on a feature map (CNN output), with each feature (point) on the map referred to as an Anchor Point. Place 9 boxes (of varying) on the picture, one for each anchor point. These anchor boxes are placed in the image at points that correlate to feature map anchor points.

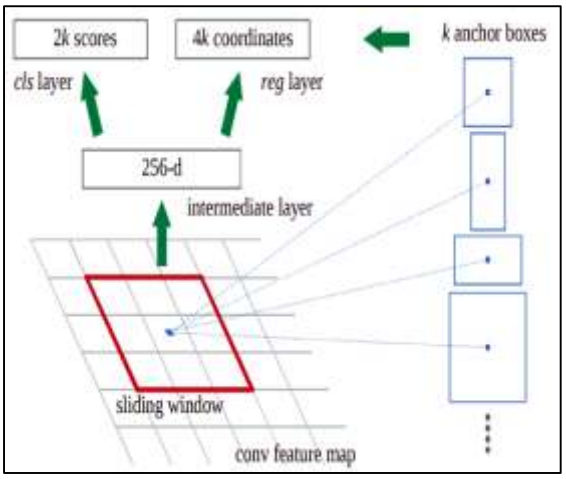

Fig. 6

3) Training of RPN:
The **foreground** is whatever is in the anchor box, and the **background** is whatever is not in the anchor box. In order to complete the processing, the following steps are taken: First, a seed point is chosen; then, adjoining pixels are appended (based on an intensity threshold); the threshold of the neighbouring pixel is checked; if both thresholds are satisfied, the region is elevated; and finally, the procedure is repeated until all regions have been raised.

D. Feature Extraction
Face images are fed into the feature extraction modulate after face recognition to detect key features used for classification. Facial information such as eyes, pose, and variation effects are calculated based on their relationship to the frontal face template.

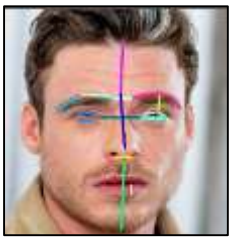
Fig. 7 Feature Extraction

1) Face Features:
- **Forehead Height:** The space between the outermost rims of the eyebrows and the forehead.
- **Middle Face Height:** Spacing between the nose's tip and the highest point of the eyebrows.
- **Lower Face Height:** The segment of space between the point of one's nose and the beginning of one's chin.
- **Left Eye Area**
- **Right Eye Area**
- **Eye to Eye Distance:** Distance among eyes.
- **Eyebrows Distance:** Horizontal distance among eyebrows.
- **Eyebrow Slope**
- **Eye Slope Sensor 1:** A system for calculating eye pitch. It is the angle of the line connecting the centre and edge points of the eye. This sensor is used to represent three different kinds of eye pitch.
- **Eye Slope Sensor 2:** Another method for calculating eye pitch. It is the difference on the Y axis between the centre and edge points of the eye. This sensor is not a ’mathematical' slope, but rather a number that can be classified as one of three types of eye pitch.
- **Nose Range:** Range of the inferior part of the nose.
- **Nose Arch:** Viewpoint of the curve of the lower edge of the nose.
- **Upper Lip Height**
- **Lower Lip Height**

2) Gray Level Co-occurrence Matrix:
GLCM is an alternate order mathematical texture analysis technique. It examines the spatial relationship between pixels and calculates the frequency of pixel combinations in an image at a given direction and distance d. Each image is quantized into 16 grey levels (0 to 15), and four GLCMs (M) for d=1 are obtained at 0 degrees, 45

degrees, 90 degrees, and 135 degrees. Each GLCM produces five distinct characteristics (Equations 13.30-13.34). As a result, each image has 20 distinct features. Each feature is normalised to a range of 0 to 1 before being passed to the classifier, ensuring that each classifier has the same set of features.

The uprooted features are classified into three types. **Primary Statistics** - Maximum intensity, Standard deviation, and Variation.

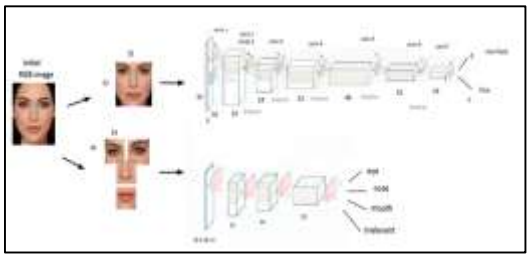

Fig. 8

Shape Features - Volume, face area, face area to volume rate, maximum 3D periphery, maximum 2D periphery for sagittal aero planes separately, major, minor, and least axis lengths, sphericity, extension, and other features are listed in alternate order. These features define the shape of the tumour areas. The third order is **Texture Features** - 16 (GLRLM) features, 16 grey level size zone matrix (GLSZM) features, 5 neighbouring grey tone difference matrix (NGTDM) features, and 14 (GLDM) features. These topographies define the texture of the tumour area.

Feature	Measure
forehead height	82.0
middle face height	68.0
lower face height	86.0
left eye area	216.0
right eye area	194.0
eye to eye dist	47.0
eye to eyebrow dist	17.5
upper lip height	6.0
lower lip height	11.0
eyebrows distance	29.0
nose length	46.0
nose width	41.0
nose arc	147.0
eyebrow shape detector 1	141.0
eyebrow shape detector 2	1.0
eye slope detector1	-0.265
eye slope detector2	1.847
eyebrow slope	-0.145

Fig. 9 Facial Feature Measurement

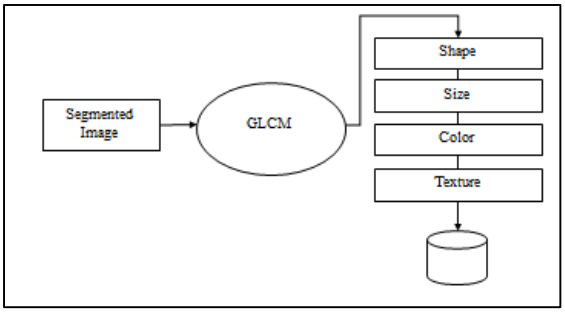

Fig. 10 GLCM

E. Face Classification

The DCNN algorithm is designed to automatically notice and reject in appropriate facial images during the registration procedure. This ensures proper registration and ensures the best possible presentation.

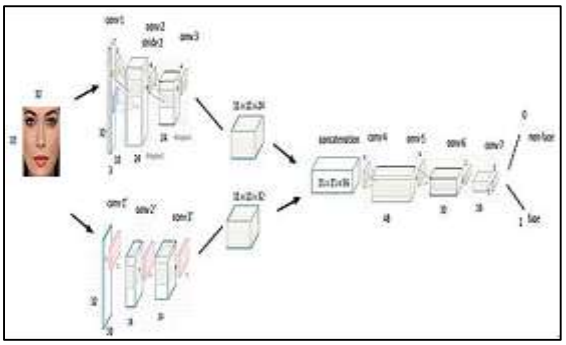

Fig. 11

A CNN generates a feature map by summing a convolution grid of vector-valued kernel inputs with a collection of filters applied to a given layer. The activations of the convolutional feature map are then computed using the nonlinear modified (ReLU). Local Response Normalization is used to normalise the new feature map acquired from ReLU (LRN). When determining the normalisation result, we additionally employ a face pooling method. Then, we zero off some of the unused weights using a dropout regularisation technique. This behaviour typically occurs in the fully linked layer that comes before the classification layer.Finally, using the softmax activation function, classify the picture label in the completely connected layer.

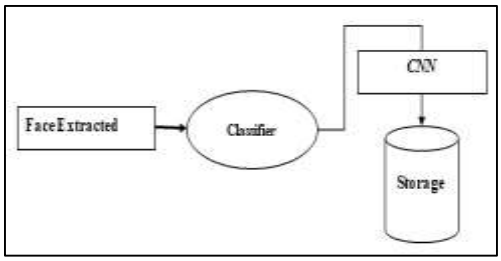

Fig. 12 Classification

F. Face Verification

This process consists of 3 steps

1) Image Capture
2) Image Analysis
3) Image Comparison

2. Result Analysis

This web application uses a combination of contemporary technologies to provide organisations with easy access to verify the validity of their employees certificates remotely. This method can help to reduce the high level of certificate manipulation and falsification in higher education.

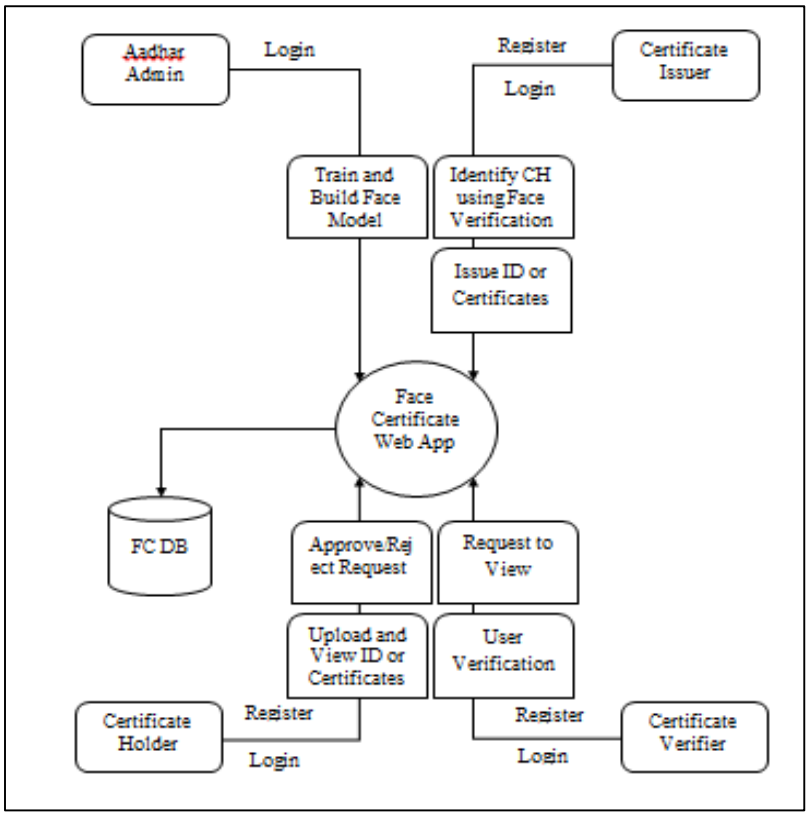

Fig. 13 Data Flow Diagram of Proposed System

TABLE I
Admin Table

Field	Constraint	Type
Id	Primary key	int(10)
userid	Foreign key	varchar(12)
details	Not Null	varchar(100)
filename	Not Null	varchar(15)
create_date	Not Null	varchar(20)
upload_by	Not Null	varchar(20)

This application uses Flask web application framework, which is lite weight and has minimal dependencies on python libraries. Bootstrap is used for designing the user interface, providing a responsive design that offers a great user experience on a variety of devices and screen sizes.

Fig. 14 Home Page

Fig. 15 Aadhar Card Issuer Registration Page

Fig. 16 Adding Details of Aadhar Card

Fig. 17 Aadhar Card Face Training

3. Conclusion

Data collection, pre-processing, training the CNN model, evaluating the model's performance, and integrating the model into a bigger system are all part of the project. The model's accuracy is determined by the quality and amount of the training images, as well as the architecture of the CNN model.

To summarise, deep learning-based facial recognition technology is a highly effective and secure way of certificate verification. Its ability to correctly identify and match an individual's face in real time, coupled with its speed, efficiency, and non-intrusive nature, makes it a preferred method for organisations across a wide range of industries. Technology is also constantly evolving, with new advances being made to improve precision and security.

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