National University of Computer and Emerging Sciences

Facial Recognition – Under Variants of Light Intensities

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Table of Contents

Table of Figures

Table of Tables

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We are grateful to Allah Almighty with the grace of that we have a tendency to were ready to complete this project. it's been a privilege to figure underneath the steering of Mubasher Baig (Assistance faculty member, Department of C.S., FAST-NUCES, Lahore). we'd prefer to give thanks him for his priceless steering, patience and motivation. we'd prefer to extend our feeling to Faiz Muhammad (who gave his valuable review and suggestions.

Abstract

The main objective to work on this project is to contribute our little part to solution of problem of facial recognition, which is surely a vast field of growth and research. We narrowed it down to dataset under variants of light intensities by Yale. **Convolutional Neural Network** is used as prime component of the solution. Moreover, different libraries of Python 3, e.g. *cv2, NumPy, keras, matplotlib, TensorFlow and O.S.*, are used. Different results are compared, followed by accuracy and error graph. This paper proposes a strategy for distinguishing facial regions by convolutional neural system. It concerns the utilization of the convolutional neural network to distinguish images and identify them in different light intensities. The methodology introduced in this paper yields better classification execution in contrast with the outcomes obtained by the Principal Component Analysis (PCA), Local Binary Patterns Histograms (LBPH) and K–Nearest Neighbor (KNN)

Chapter 1: Introduction

Purpose:

Facial recognition is the issue of recognizing and checking individuals in a photo by their face. It is an assignment that is inconsequentially performed by people, much under differing light and when countenances are changed by age or impeded with extras and facial hair. By and by, it is stayed a difficult PC vision issue for a considerable length of time as of not long ago.

Project Description:

Profound learning strategies can use extremely huge datasets of countenances and learn rich and smaller portrayals of appearances, permitting current models to initially proceed also and later to beat the face acknowledgment capacities of people. It is a procedure contained location, arrangement, include extraction, and an acknowledgment task Profound learning models initially moved toward then surpassed human execution for face acknowledgment undertakings. Convolutional Neural Networks permit us to separate a wide scope of highlights from pictures. Turns out, we can utilize this thought of feature extraction for face acknowledgment as well. That is the thing that we will investigate in this paper, utilizing profound conv nets for face acknowledgment. Facial recognition tells whose face it is, not simply recognizing faces in an image.

Objectives:

- To keep track of thieves
- Security tool for personal devices
- To provide efficient data to surveillance monitoring systems

Gap:

In the literature review, there were methods available which can only test facial recognition under same intensities of light. There was no specific paper found specifically on variants of light intensities. This paper is little effort to contribute towards that niche.

Chapter 2: Literature Review

About 5 Research Papers have been studied in which electromagnetic waves were focused. Key features in these papers are as follow.

Paper Title	Purpose	Technique Used	Drawbacks	Key Points
Implementation of Face Recognition Algorithm for Biometrics Based Time Attendance System	Biometric based time attendance system	fisher face	Old technique used	Attendance Fisher face
Robust Representation and Recognition of Facial Emotions Using Extreme Sparse Learning	Recognition of natural emotions from human faces	Extreme learning machine		Power of elm. Noisy signals and imperfect data

3D Facial Expression Recognition with Geometrically Localized Facial Features	Use of 3D acquisition system for facial expression recognition	Probabilistic Neural Network	Only limited to few expressions	Distance vector PNN
Effects of Facial Mood Expressions on Face Biometric Recognition System's Reliability	To detect facial changes due to the user's emotional condition or facial mood expression can affect the reliability of recognition system	CVPR	Old technique used	CVPR facial recognition Detect mood difference

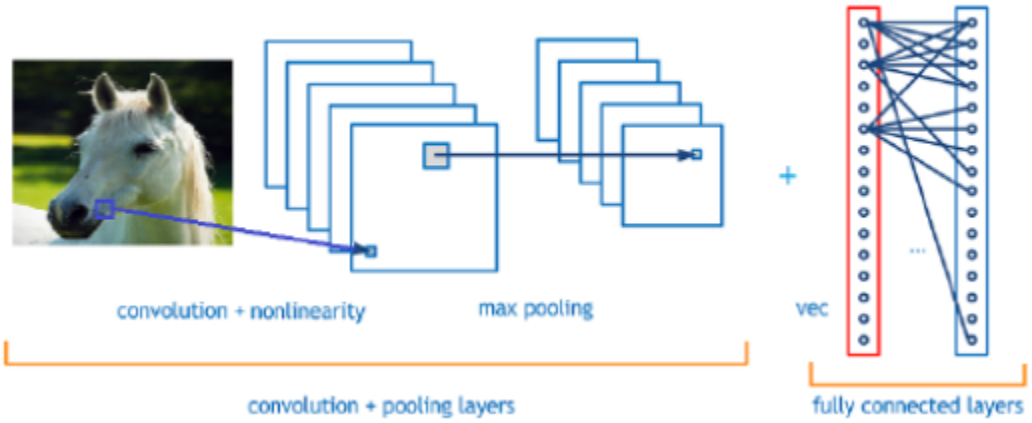
Table 2-1: Review of different research papers

Chapter 3: Methodology (Convolutional Neural Network)

CNNs are a category of Neural Networks that have proven very effective in areas such as image recognition and classification. CNNs are a type of feed-forward neural networks made up of many layers. CNNs consist of filters or kernels or neurons that have learnable weights or parameters and biases. Each filter takes some inputs, performs convolution and optionally follows it with a non-linearity. The structure of CNN contains:

- Convolutional
- Pooling
- Rectified Linear Unit (ReLU)
- Fully Connected layers.

A typical CNN architecture is given below:



1. Convolutional Layer:

Convolutional layer performs the core building block of a Convolutional Network that does most of the computational heavy lifting. The primary purpose of Convolution layer is to extract features from the input data which is an image. Convolution preserves the spatial relationship between pixels by learning image features using small squares of input image. The input image is convoluted by employing a set of learnable neurons. This produces a feature map or activation map in the output image and after that the feature maps are fed as input data to the next convolutional layer.

2. Pooling Layer:

Pooling layer reduces the dimensionality of each activation map but continues to have the most important information. The input images are divided into a set of non-overlapping rectangles. Each region is down-sampled by a non-linear operation such as average or maximum. This layer

achieves better generalization, faster convergence, robust to translation and distortion and is usually placed between convolutional layers.

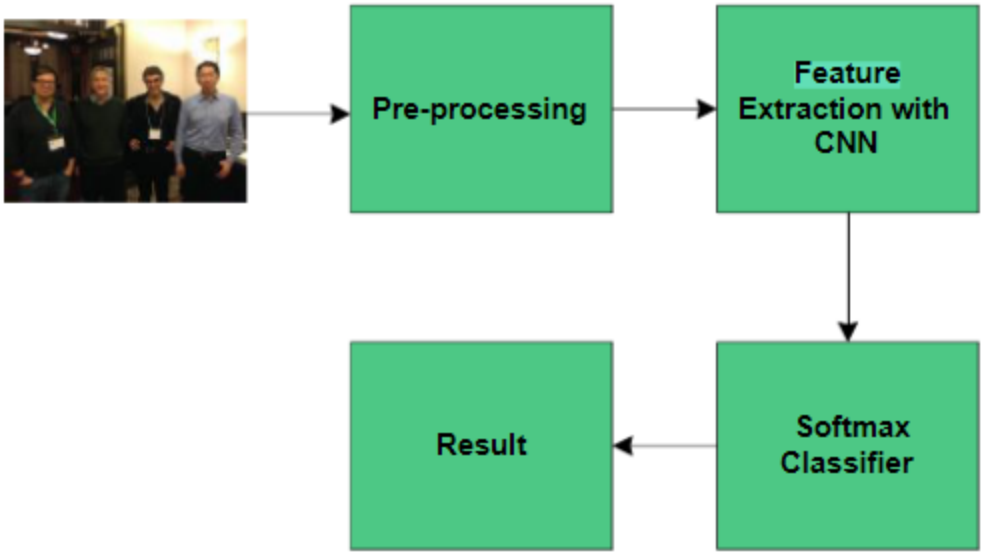
3. ReLU Layer:
ReLU is a non-linear operation and includes units employing the rectifier. It is an element wise operation that means it is applied per pixel and reconstitutes all negative values in the feature map by zero. In order to understand how the ReLU operates, we assume that there is a neuron input given as x and from that the rectifier is defined as $f(x)= \max(0,x)$ in the literature for neural networks.

4. Fully Connected Layer:
Fully Connected Layer (FCL) term refers to that every filter in the previous layer is connected to every filter in the next layer. The output from the convolutional, pooling, and ReLU layers are embodiments of high-level features of the input image. The goal of employing the FCL is to employ these features for classifying the input image into various classes based on the training dataset. FCL is regarded as final pooling layer feeding the features to a classifier that uses SoftMax activation function. The sum of output probabilities from the Fully Connected Layer is 1. This is ensured by using the SoftMax as the activation function. The SoftMax function takes a vector of arbitrary real-valued scores and squashes it to a vector of values between zero and one that sum to one.

3.1 Proposed Algorithm

The algorithm is mainly carried out in three steps as below:

1) Resize the input images.
2) Build a CNN structure with eight layers made up of convolutional, max pooling, convolutional, max pooling, convolutional, max pooling, convolutional, and convolutional layers respectively.
3) After extracting all features, use SoftMax classifier for classification.



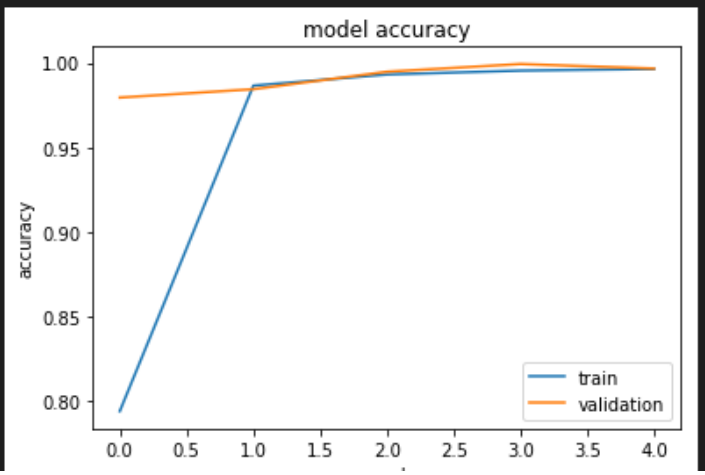
3.2 Dataset

We will be using a dataset of images captured at different light intensities and we will try to distinguish facial regions by convolutional neural system. Given below is the idea of dataset of images taken at different light intensities.

Chapter 4: Conclusion

Designed system is able to distinguish and detect faces under verities of light intensities with loss: 0.0068 – accuracy: 0.9985. Accuracy graph is also plotted to clarify the contrast between validation and training dataset.

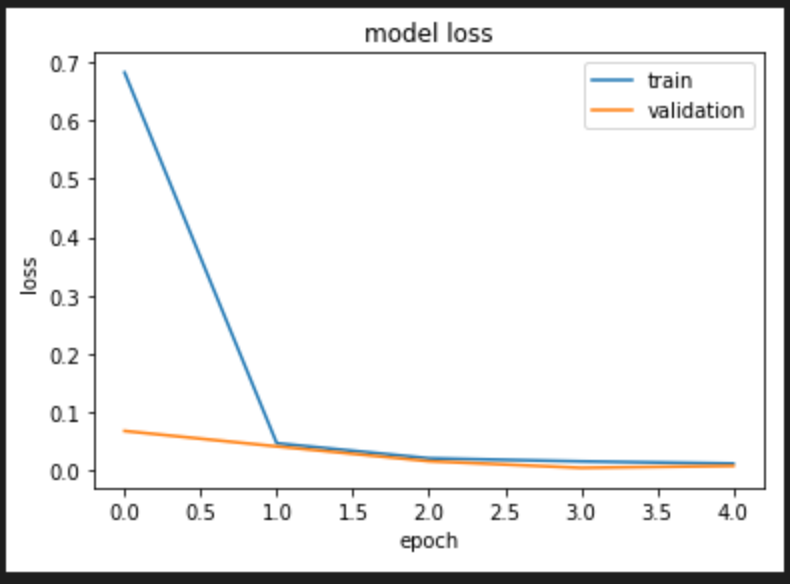
```
[51]  M↓
plt.plot(history.history['acc'])
plt.plot(history.history['val_acc'])
plt.title('model accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'validation'], loc='lower right')
plt.show()
```



Loss graph is attached below as well. **PFA**

[52]

```
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'validation'], loc='upper right')
plt.show()
```



Recommendation:

Furthermore, to make it more user-friendly android application could be developed that takes these datasets and can draw accuracy of test image with feed dataset.

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