The effect of optimizers in fingerprint classification model utilizing deep learning

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Article Info	ABSTRACT
	Fingerprint is the most popular way to identify persons, it is assumed a unique identity, which enable us to return the record of specific person through his fingerprint, and could be useful in many applications; such as military applications, social applications, criminal applications… etc. In this paper, the study of a new model based deep learning is suggested. The focus is directed on how to enhance the training model with the increase of the testing accuracy by applying four scenarios and comparing among them. The effects of two dedicated optimizers are shown and their contrast enhancement is tested. The results prove that the testing accuracy is 85.61% for "Adadelta" optimizer, whereas for "Adam" optimizer, it is 91.73%.

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1. INTRODUCTION

The fingerprint is considered one of the most important methods used to identify people, especially it is unique to each person, and cannot be doubled, where people information can be retrieved by relying on the fingerprint. But this print may be latent and not clear, so by using computer vision in many fields of image processing for example improve the intensity of grey image and increase the contrast of image. On the other hand, the propelled deep learning capacities, and especially convolutional neural systems (CNN) specifically, are essentially propelling the best in class in PC vision and example acknowledgment. The deep CNN is an organically propelled variation of multilayer perceptron and speaks to a common deep learning engineering. Deep learning is dynamically showing its huge in areas of valuable application [1].

In this way, researchers are inquiring about and creating Deep learning strategies that are turning out to be progressively ideal. Wong et. al [2, 3] proposed a multi task model to enhance latent fingerprint by increasing the contrast and denoise it based CNN with very satisfied results, Imane Hachchane et. al [4] studied the face detection using fisher vector and bag of visual words with those same CNN features with satisfied results, but didn't focus on the optimizers and their effects.

In [5] proposed a model to identify and recognize fingerprint usin CNN, they focused on the speed of training and presented a very high speed model. In [6] the authors suggested to decrease the quantity of correlations in programmed unique finger impression acknowledgment frameworks with huge databases. The mix of utilizing PC vision calculations in the picture pre-handling level expands the figuring time. In [7] proposed a new study in analyzing the effects of varing the filters on accuracy of CNN model, based classifiers using human face, fingerprint and iris for person identification.

In [8] view of examination singularities and edges relating particular focuses. As a result of low-quality pictures, it is extremely hard to get right places of solitary highlights. The creators utilized investigation edge following and bends highlights to characterize fingerprints. An AI calculation that takes a

vigorous way to deal with the order of fingerprints is SVM. This technique has made an exceptionally exact grouping framework. The benefits of the calculation are appeared in the grouping of fingerprint into various levels. The researchers of [9] utilized a blend of the SVM calculation with the innocent Bayes technique to characterize fingerprints dependent on the quantity of center and delta focuses on fingerprint. Numerous scientists have attempted to separate particular focuses in the progression of the edges [10]. The authors of [11–13] investigated a heuristic calculation with originalities to characterize fingerprint, the disservice of these investigations isn't concentrating on improving picture quality.

Since the authors used features of idiosyncrasy centers position. Which prompts an uncommon impact on the exactness of the model. The Galton-Henry course of action plot is used to arrange fingerprint. This methodology is shown in [14]. The researchers used unrest invariant partition, by then facilitate this detachment between the Finger-Code test set with the new special imprint structure. During the game plan method, the rotate invariant division extraction occurs in relating with the planning methodology. Which presents the favored situation of speedy the time of system. The Random Forest (RF) figuring is used to manage huge w holes of multi-level issues [15].

In [16] proposed a soybean disease detection model based on CNN and weight optimizer this model had provided good results but this type of optimizer is not preferred because some variables are constrained to be integers. In [17] proposed multi bioinfomatics model it was very good model with enhnacement algorithms but it did not study the effect of optimizers on the model. In [18] studied identify the finger vein detection based CNN model with very accepted results but they focused on finger vein rather than finger print identifying.

This article targets furnishing the reader with instincts concerning the conduct of various calculations for streamlining the preparation, and shows the effect of optimizers in fingerprint dataset training accuracy and also shows the effect of increasing contrast of image using histogram equalization by four scenarios as will be shown later.

2. ADADELTA

Adadelta [19] is a monotonically diminishing learning rate. Rather than collecting all past squared inclinations, Adadelta limits the window of aggregated past angles to some fixed size w. Rather than wastefully putting away w past squared inclinations, the total of angles is recursively characterized as a rotting normal of all past squared slopes. The running normal $E[g2]t$ at time step t at that point depends (as a portion γ likewise to the Momentum expression) just on the past normal and the present angle:

$$E[g2]t = \gamma E[g2]t\text{-}1 + (1 - \gamma)gt2$$

set γ to a similar value as the momentum term, around 0.9. For clarity, we now rewrite our vanilla SGD update in terms of the parameter update vector $\Delta\theta t$:

$$\Delta\theta t = -\eta \cdot gt,i$$
$$\theta t+1 = \theta t + \Delta\theta t$$

3. ADAM

Abbreviate to Adaptive Moment Estimation, is very important technique that figures versatile learning rates for every parameter. Notwithstanding putting away an exponentially rotting normal of past squared angles vt like Adadelta, Adam likewise keeps an exponentially rotting normal of past inclinations mt, like energy [20]:

$$vt = \beta2vt-1 + (1 - \beta2)g\,t2$$
$$mt = \beta1mt-1 + (1 - \beta1)gt$$

Where mt and vt are assessments of the main minute (the mean) and the subsequent minute (the uncentered change) of the slopes separately, henceforth the name of the technique. As mt and vt are instated as vectors of 0's, the creators of Adam see that they are one-sided towards zero, particularly during the underlying time steps, and particularly when the rot rates are little and close to 1 ($\beta1$ and $\beta2$). They balance these predispositions by registering inclination redressed the minutes of first and second appraisals [21]:

$$1 - \beta\,t1$$
$$m\hat{\ }t = mt /1 - \beta\,t1$$
$$v\hat{\ }t = vt1 - \beta\,t2$$

4.   PROPOSED SYSTEM

This research focuses on create deep learning model based on CNN technique to make training, recognition and then classification to fingerprint, using Kaggle dataset consists from 80 print for 8 persons, ten prints to each one, Figure 1 shows the diagram of this model:
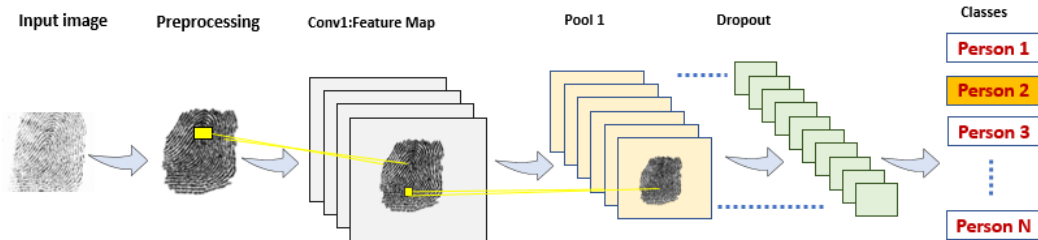

Figure 1. Model diagram

In this model, four Convolutional layers are used with depth (3X3X32,3X3X64,3X3X128, 3X3X128) sequentially, and each one is followed by max polling layers with filter size (2X2) for each one, and then drop out of (0,3) is used.

5.   DATASET

The third international fingerprint verification competition "FVC2004 DB1_B" dataset is utilized in this research [22], it collected in The Biometric Systems Lab (University of Bologna), the Pattern Recognition and Image Processing Laboratory (Michigan State University) and the Test Center (San Jose State University), each image size is 640x480 (307 Kpixels) scanned by optical sensor "V300" by CrossMatch with resolution 500dpi.

First of all, the model starts with loading the dataset, which is classed to 5 identities, each identity has ten prints for the same finger, by using keras's "ImageDataGeneratorlibrary" class, new data generated to slightly augment the data with shifts, rotations, zooms, and mirroring, Figure 2 shows sample of augmented dataset.
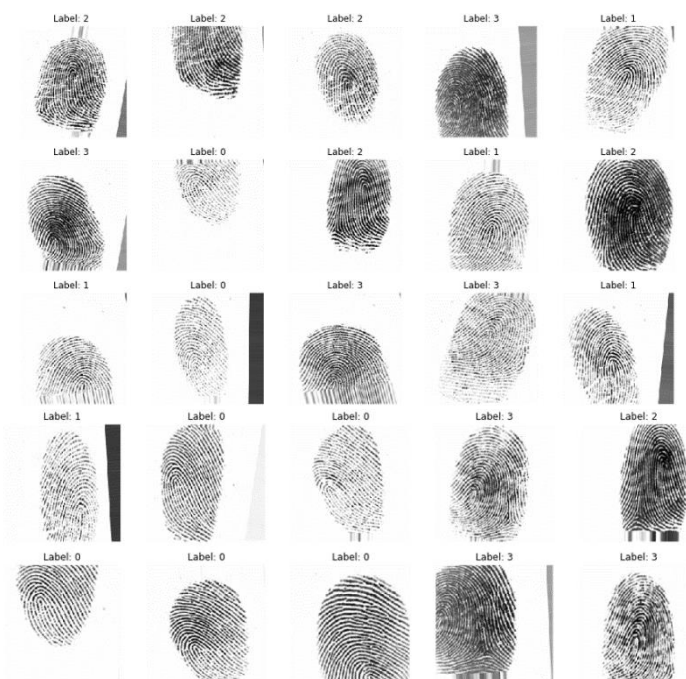

Figure 2. Augmented dataset

6.   RESULTS AND DISCUSSION
In this research, the code in [23] is depended as reference with some modifications in size of images in dataset and in the number of classes, which is considered as five instead of ten classes, to be compatible with fingerprint application, and the modification codes of this research is in [24, 25].

6.1. Scenario 1
In this scenario, using "Adadelta" Optimizer in CNN Model, without using histogram equalization to see the effect of "Adadelta" without enhancing in contrast, the training epochs are 11/40 with testing accuracy = 85.61%, Figure 3(a) shows the accuracy with epochs of training and testing operations.

6.2. Scenario 2
The Optimizer is changed with "Adam", Figure 3(b) shows the accuracy testing without using histogram equalization, the training epochs are 40/40 with testing accuracy = 91.73%.

6.3. Scenario 3
In this scenario, histogram equalization is used to enhance the contrast of fingerprint, with "Adadelta" Optimizer, where the training epochs are 14/40 and the testing accuracy = 61.84% Figure 3(c) shows the accuracy testing in this scenario.

6.4. Scenario 4
In this scenario, histogram equalization is used to enhance the contrast of fingerprint, with "Adam" Optimizer, where the training epochs are 14/40 and the testing accuracy= 37.24% Figure 3(c) shows the accuracy testing in this scenario.
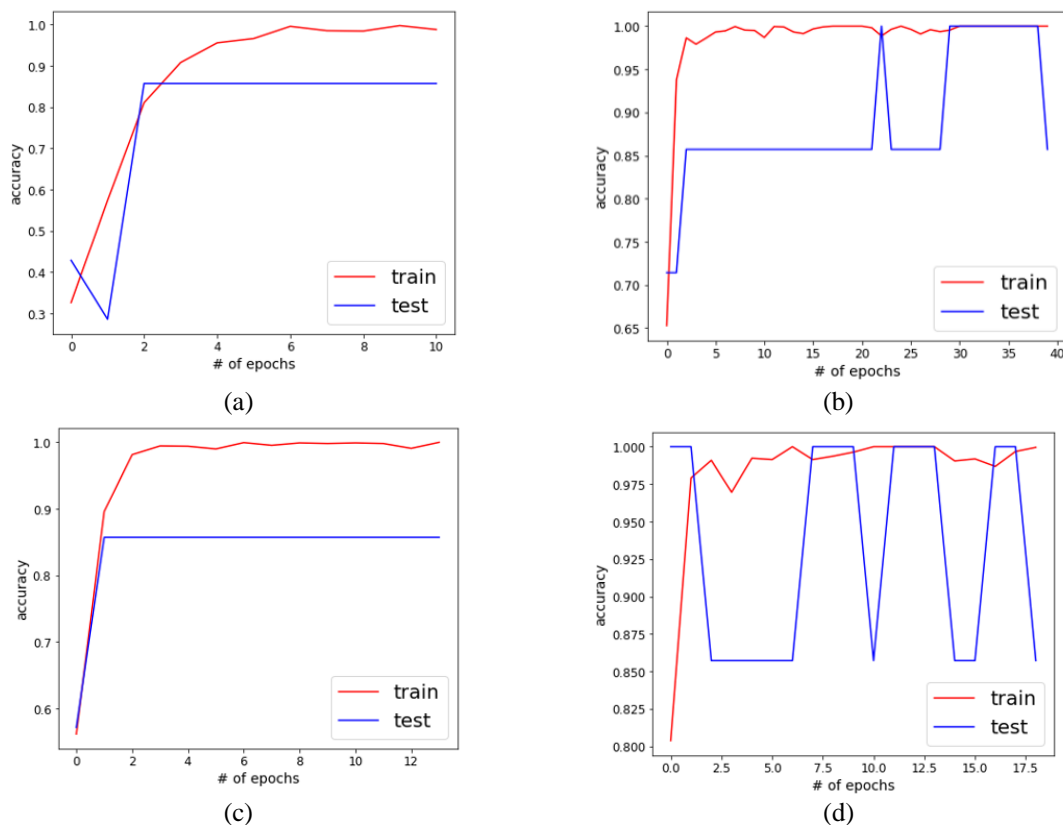

(a)   (b)

(c)   (d)

Figure 3. the accuracy with epochs of training and testing operations

7.   CONCLUSION
The model is implemented and tested, CNN algorithm is used in proposed model and experiment in four scenarios, first one with "adadelta" Optimizer and the testing accuracy = 85.61%, while the second

scenario when used "Adam" Optimizer, the testing accuracy = 91.73%, as a result, "Adam" Optimizer is more efficient than "adadelta" in fingerprint classification application, in addition, the third and fourth scenarios show that after using histogram equalization algorithm in fingerprint application does not enhance the fingerprints for classification as appears in the enhanced image where the contrast of image become sharpener with high contrast, but it does not increase the accuracy of classification where the accuracy was 61.84% and 37.24% with "Adadelta" and "Adam" Optimizer.

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