JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Multimodal Biometric Artefact Detection Mechanism

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Abstract: The convolutional neural network (CNN) has revolutionized the field of image processing and pattern recognition. The filters of the CNN model correspond to the activation maps that extract features from the input images. Therefore, the number of filters and filter size are crucial to learning and recognition accuracy of CNN model-based systems, such as the biometric-based person authentication system. In the existing paper, it is suggested that the accuracy of biometric-based single classifiers that use the human face, fingerprint, and iris for person identification, as well as biometric- based super-classification using both bagging- and programming-based boosting methods, be examined in relation to the effect of changing the number of filters in CNN models. The current research provides insight into the ideal configuration of CNN model filters that results in the greatest overall accuracy of the classifier system.

Keywords: Biometric, Security, Deep learning, CNN, VGG16.

I.INTRODUCTION

A security procedure called biometric verification uses an individual's distinctive biological traits to confirm that the person is, in fact, who they say they are. Technologies for biometric identification match the collected biometric data to authentic data that has been learned and stored in a database[1]. Face, fingerprint, & iris biometrics are the most widely used and accessible. Computer scientists have made astonishing advancements in reducing the error rates in pattern recognition, picture categorization, and other applications in the area of computer vision thanks to CNN, a revolutionary and dramatic change in the field of neural networks. A security procedure called biometric verification uses an individual'sdistinctive biological traits to confirm that the person is, in fact, who they say they are. Technologies for biometric identification match the collected biometric information with authentic data that has been learned and stored in a database[1]. Face, fingerprint, & iris biometrics are the most widely used and accessible. Computer scientists have made astonishing advancements in reducing the error rates in pattern recognition, picture categorization, and other applications in the area of computer vision thanks to CNN, a revolutionary and dramatic change in the field of neural networks.

'Deep learning' (DL) is also known as 'hierarchical learning' or 'deep-structured learning' [3]. While task- based approaches are based on learnt data representation, deep learning (DL) is a sort of machine learning technique where learning can be supervised, unsupervised, or semi-supervised. The working of biological nerve systems, namely how information is processed and conveyed in them, is a loose inspiration for the models of DL. These DL methods are, however, physically and functionally unlike from human brains. They are irreconcilable with the findings of neuroscience due to these disparities. Convolutional neural networks (CNN), deep learning (DL) networks, recurrent neural networks (NN), as well as deep belief networks are architectures of DL that have been used in a variety of research fields, such as speech recognition, computer vision (CV), audio recognition, language manipulation, machine translation, social media site filtering, drug design, bioinformatics, processing of medical images, board game programmes, and material analysis. These cutting-edge machine learning algorithms have produced outcomes on par with, and in some cases better than, those produced by humans.

Convolutional neural network (CNN)

The convolutional neural network (CNN) is a ground-breaking advancement in the artificial neural network (ANN) field since it not only addresses ANN's drawbacks but also achieves previously unheard-of levels of accuracy in machine learning and recognition. The convolutional layer, the pooling layer, and the fully connected layers are the three different types of layers that make up the majority of the CNN [4]. These layers are stacked together to create the entire CNN design. The benefit of employing CNN over conventional ANN is that CNN results are unaffected by visual modifications including picture scaling, translation, and rotation. Additionally, CNN-based models provide significantly higher overall accuracy in learning and recognizing classifier systems.

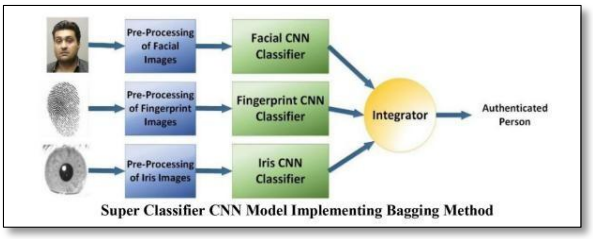


Figure 1: Super-classifier CNN model implementing bagging method[4]

The organization of this paper is as follows. Section II describes shows the literature survey In section III, we describe the proposed methodology. Experiments and results are discussed in Section IV. Finally, conclusions are presented in Section V.

II. LITEARATURE SURVEY

Sarker et al.,(2021) suggested looking at how changing the number of CNN filters affects the precision of biometric-based single classifiers that use the human face, fingerprint, and iris for person identification, as well as biometric-based super- classifiers that employ both bagging- and programming-based boosting techniques.

Hui et al.,(2020) For multimodal biometric recognition, we offer an end-to-end trainable CNN model where high-level feature may be abundantly retrieved by convolution operation. Additionally, convolutional and pooling layers are applied to the combined features in order to produce a more informative feature representation. In particular, a set of degraded image sets is used to verify the proposed method's robustness. The suggested CNN model is shown by experimental data to be robust to typical picture degradation and relevant to the identity recognition problem, in addition to being able to attain a recognition rate of 98.84% in testing.

Shende et al.,(2020) primary goal of this study is to present a convolutional neural network for face, fingerprint, and palm vein that has the fewest layers possible while yet maintaining good accuracy and minimizing complexity. The network consists of 10 hidden layers in the fully connected layer, two convolutional layers, two ReLU layers, and two Maxpooling layers. For all modalities, the 4500 image dataset is produced. Images from the dataset are utilized for testing (30%), validation (10%), and training (60%). The accuracy of the proposed CNN architecture is 95% for face, 94% for fingerprint, and 99% for palm vein. The CNN, which had the fewest layers possible, consistently performed well across all biometric modalities while maintaining good accuracy.

Xuekui et al.,(2015)provided new characteristics, such as palm-vein or finger-knuckle prints, which are being used to identify people today. A contactless identification method called palm-vein uses the veins under the skin to identify a person. They are more dependable and safe. The characteristics of palm veins are extracted using wavelet or curvelet transforms. The final variable is 0.16, for example, for EER. The weakness of this framework, which needs to be fixed, is processing time.

Abe et al., (2015) a novel method called Minutiae Relation Code (MRC) was introduced, which consists of vectorized descriptors determined by minutiae information for fingerprints. The vector sets contain the information between arbitrary minutiae. Findings are highly accurate. The Equal Error Rate is 0.82 as well. The Minutiae Relation code's drawback is that it only makes use of a small number of fingerprint image attributes. Since overlapping of characteristics is not defined, authentication is impacted.

Koutraset al.,(2018) Using contemporary CNN based architectures, we will discuss our solution to the issue of audio-visual salient event recognition based on visual and auditory modalities. Authors found strong evidence that the CNN-based approach for all modalities (i.e., audio, visual, and audiovisual), even in this task, manages to outperform the hand-crafted frontend in almost all cases, achieving really good average results. The COGNIMUSE a database consisted of films and travel documentaries in addition to ground-truth data indicating the perceptually mono- as well as multimodal salient events.

Xiaochun et al.,(2022) It is suggested to use a bi- directional LSTM parallel model with an attention mechanism based on a 1-D convolution neural network (ConvBLSTM-PMwA). On publicly available UCI and WISDM HAR datasets, the performance is assessed. The findings demonstrate that, even when dealing with noisy HAR data, the ConvBLSTM-PMwA model outperforms the current CNN and RNN models in terms of classification accuracy (96.71%) and computational time complexity (at least 1.1 times faster).

Mingjie et al.,(2021) introduced the 3M-CNN model, which is based on multiscale kernels and multimodal remote sensing data. In Wuhan, China, experiments based on two ZiYuan-3 (ZY-3) satellite imageries of various periods and seasons were carried out. The suggested 3M-CNN model surpassed other comparable models, according to the findings, and obtained outstanding overall accuracies on two separate images.

Alsuhibany & Alquraishi (2021) advocated the use of a deep learning-based technique for biometric cracking. This mechanism was used to assess the biometric's usability and security. The system guarantees precise feature extraction. The classification accuracy statistic was used to assess the effectiveness of the suggested strategy.

III. PROPOSED WORK

PROBLEM FORMULATION

The Problems discovered and solutions corresponding to the problems are discussed in this section. The discovered problem fall under the category of definition and rectification and objectives are part of the objective of the study.

- **Problem Definition**

The Biometric is used for the detection of security issues that are present within the website accessing.

The main attacks will be in the form of bots. The detection mechanisms can cause an issue in case features are not appropriately extracted from the image. The existing system's entropy-based approach can only extract features from simple images. The entropy of other images is decreased and hence no features are extracted from the complex images. Support vector machine is not capable of extracting feature accurately from this purpose focal function is required to be modified. The multi focal loss function can be used to increase or decrease the entropy of the images for accurate feature extraction.

The overall process will increase the classification accuracy of the Biometric recognition. The pre- processing mechanism employed within the existing system also requires change. The color scaling with feature extraction mechanism could be used to increase the detection process.

- **Objective of the study**

The objective associated with the proposed system is to increase the classification accuracy of the detection process. The overall process of detection is represented as under: -

- To implement deep learning model VGG16 based feature extraction of Biometric Images
- To develop a resnet deep learning model for biometric images recognition

To prove the validity of the approach by the use of metrics such as classification accuracy, specificity and sensitivity.

Dataset Used

The performance of the proposed mechanism is tested using succoring Biometric. There are 1024

images in the collection. The images are all in RGB format. 600 images are defined in the train set, while 424 images are specified in the test set.

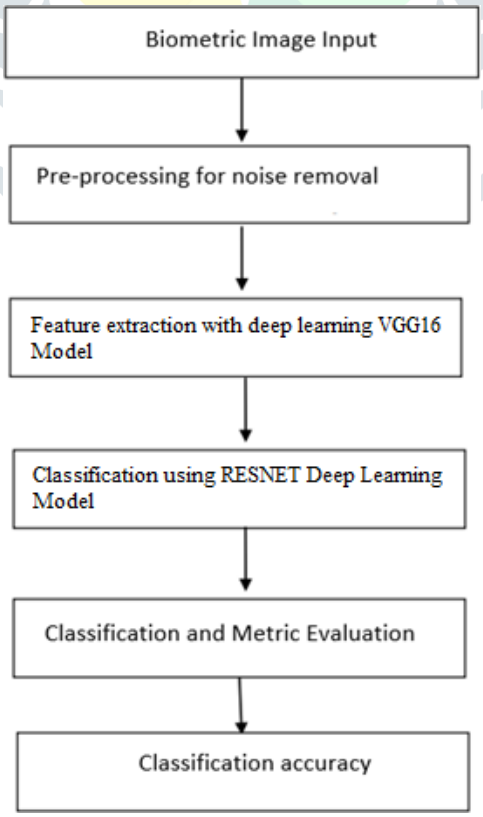


Figure 2: Flow of Methodology.

- The methodology for biometric image classification using deep learning models involves the following steps. First, a dataset of biometric images with corresponding labels is collected, ensuring diversity and representativeness. The images may need to be resized to a standardized resolution and converted to a suitable format, such as RGB or grayscale.
- Next, pre-processing techniques are applied to remove noise and improve image quality. This can include methods like Gaussian blur, median filtering, or total variation

denoising. Additionally, normalizing the pixel values to a common range, such as [0, 1], is performed to facilitate model training.

- For feature extraction, a deep learning model like VGG16 is used. The pre-trained VGG16 model, which has been trained on large-scale image datasets, is employed. The fully connected layers of the VGG16 model are removed, leaving only the convolutional layers. The biometric images are fed through the modified VGG16 model, and the outputs from the last convolutional layer serve as the extracted features.
- After feature extraction, a classification model is utilized for biometric image classification. In this case, a RESNET deep learning model is employed. The extracted features from the previous step are input to the RESNET model, which is trained to classify the biometric images into the desired classes.
- Finally, the classification results are evaluated using appropriate metrics. Common metrics for classification tasks include accuracy, precision, recall, and F1- score. The model's performance is assessed on a separate test set that was not used during training or validation.
- Overall, this methodology combines pre- processing techniques, feature extraction using VGG16, classification using RESNET, and metric evaluation to effectively classify biometric images using deep learning models.

IV. RESULTS

Python is a high-level general-purpose programming language that is viewed. With its use of substantial indentation, its design concept underscores readability of the code. Its speech structures as well as object-oriented method are intended to assist programmers in writing clear, logical code for small and large-scale projects. Python is garbage-collected as well as interactively transcribed. It contains a range of development methodologies, such as structured (especially procedural), object-oriented, as well as functional programming. Because of its extensive standard library, it is frequently referred to as a "batteries included" language. Guido van Rossum started developing Python as a successor to the ABC computer language in the late 1980s, & it was first originally known as Python 0.9.0. Python ” was launched in 2000, & it included innovative features like list comprehensions as well as a garbage collection scheme that used reference counting. Python 3.0, which was published in 2008, was a major reform of the vocabulary that was not fully backward-compatible. Python 2 was phased out with edition 2.7.18 in 2020. Python is ranked among the top as one of the most widely researched computer languages.

Authors test our methodology using the 1024-class Biometric Dataset CodeDataset classification database. The models are tested on the validation photos after being trained on the training images. Training more complex neural networks is more challenging. Also offer a residual learning framework to make it simpler to train networks that are much deeper than those previously employed. As opposed to learning unreferenced functions, we deliberately redefine the layers to acquire residual functions with reference to the layer inputs. For many visual recognition tasks, the depth of presentations is crucial.

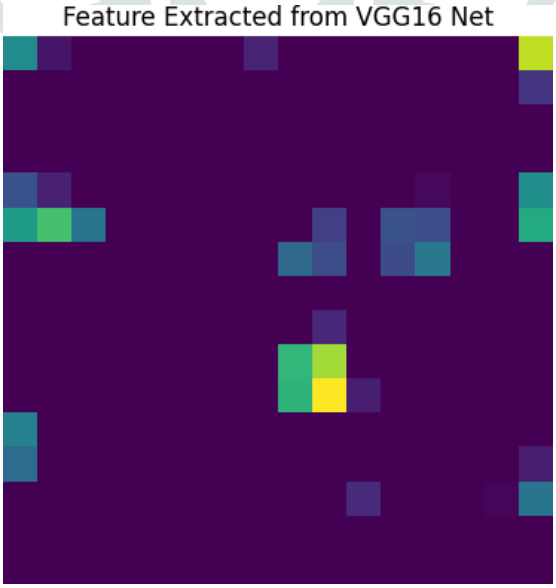


Figure 3:Features extracted from VGG16 Net

Accuracy: The most popular measure for classification performance is accuracy. Accuracy is calculated by dividing the set of correctly classified instances by the total number of samples, whereas error rate is calculated by dividing the set of incorrectly classified instances by the set of correctly classified instances.

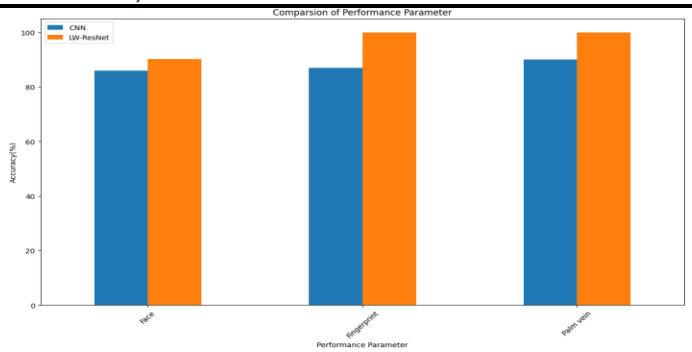


Figure 4: Comparsion of Performance Parameters

From the above results show that the proposed approach Resnet gives the accuracy 94%,precision ,Recall, F-Score which is far better as compared to existing techniques

V. CONCLUSION

Huge volumes of data with the traits of high volume, high diversity, high velocity, and high veracity are generated as a result of the widespread deployment of heterogeneous networks. These data, also known as multimodal big data, are extremely challenging for conventional data fusion techniques because they include a wealth of cross-modality or intermodality information. In the current study, we have examined how different CNN filter counts affect the overall accuracy of CNN-based classifier systems. Our

True Positives False Negatives

=No.of correctly Predicted Positive Instances No.of Total Positive Predictions you Made

theory which has been supported by the current experiment that the set of CNN filters that roughly

From the figure 4 is clearly show that the accuracy increase 94% for the proposed technique as compared to existing approaches.orresponds to the same system accuracy is really more or less a superset of the most fundamental or typical filter set has been strengthened. From the above results show that the proposed approach Resnet gives the accuracy 94%,precision ,Recall, F- Score which is far better as compared to existing techniques

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