2021 20th International Symposium on Distributed Computing and Applications for Business Engineering and Science (DCABES)

Application of CNN-based Face Recognition Technology in Smart Logistics System

Geng Miao
Wuxi Taihu University,Wuxi 214064,China
Jiangsu Key Lab of IoT Application Technology, Wuxi Taihu University,Wuxi 214064,China

***Abstract*—Smart logistics combines the Internet of Things with big data, cloud computing and other information processing technologies to improve all aspects of logistics business and optimize the status quo of logistics services. This research aims to study the application of Convolutional Neural Network-based face recognition technology in intelligent logistics systems. First, briefly describe the key concepts of Faster Region with CNN feature, convolutional neural networks, the essence of smart logistics, and the background of the overall architecture design of CNN-based smart face recognition logistics, including data modules, data storage modules, and data presentation layers. Analysis of bottlenecks in other smart logistics systems, such as time-consuming large-capacity storage. By choosing WIDER Face as the sample training set and FDDB as the sample test set, the traditional face detection algorithms are compared. Experimental results show that CNN has the fastest detection speed. And the loss rate of CNN is low, and the accuracy can reach 91% under the condition of unlimited faces.**

Keywords-Convolutional Neural Network; Face Recognitio; Smart Logistics; Logistics System

I. INTRODUCTION

With the rapid development of electronic information and Internet technology and in-depth network traffic increasing rapidly, data security is becoming more and more important [1]. Compared with traditional authentication methods, identity recognition is an important part of information security [2]. Biometric elements have many advantages, such as uniqueness, strong anti-counterfeiting in actual use, and strong memory [3]. Facial data is a natural way of communicating with each other and is usually easily accepted by the public. Compared with fingerprints and iris, collecting faces does not require the cooperation of the collector, and the collection process is more natural [4-5].

Based on the above advantages, face recognition has always been a research hotspot in academia, attracting the research interest of the majority of researchers, and the results are also remarkable. Lu J proposed a Face Recognition method that is easy to train and based on a single CNN. Their CNN model utilizes the remaining learning framework. In addition, it uses standardized features to calculate the loss. Their large number of experiments show that they have good generalization ability on different data sets. They have obtained very competitive and state-of-the-art results on LFW, IJB-A, YouTube faces and CACD datasets [6]. Peng C proposed a new heterogeneous face recognition (HFR) method based on graphical representation. The Markov network is used to represent the heterogeneous image blocks, and the spatial compatibility between adjacent image blocks is considered. A coupled representation similarity measure (CRSM) is designed to measure the similarity between graphical representations. Extensive experiments on multiple HFR scenes (view sketches, forensic sketches, near-infrared images, and thermal infrared images) show that the proposed method outperforms the state-of-the-art methods [7-8]. Therefore, the study of face recognition based on CNN has high practical significance.

The innovation of this paper is to use a convergent neural network to create a logistics approval system based on face recognition. At the same time, through face recognition, the misunderstandings and situations in the traditional logistics links are eliminated. Wrong downloads will reduce errors in the signing process. On the other hand, the information verification time in the signature process is shortened, and the efficiency of the signature is improved. This research can further improve the accuracy of face recognition in offline logistics, at the same time improve the efficiency of offline logistics, and further accelerate the information development of the logistics industry.

II. RESEARCH ON CNN-BASED FACE RECOGNITION TECHNOLOGY IN SMART LOGISTICS SYSTEM

A. Convolutional Neural Network

Convolutional neural network has become a research hotspot in the field of language and visual perception [9]. Convolutional neural networks are multilayer perceptrons, especially used to recognize two-dimensional graphics, such as conventional filters, but this network structure has strong resistance to tilt, scaling, deformation, or other forms of distortion. It can be customized to avoid the traditional process of extracting complex features and reconstructing data.

B. The Overall Architecture Design of CNN-based Face Recognition Smart Logistics

The essence of logistics is to serve customers and markets. The logistics industry is a complex service industry that has important strategic significance to the country's economic development. The comprehensive service functions of logistics enterprises and the nodes in the city improve the quality of logistics services, and it is of great significance to realize logistics modernization [10-11].

Before the development of the system, it is necessary to build the overall framework of the face recognition logistics system based on deep learning. The overall process of face recognition is designed in this way. The following mainly introduces the overall architecture design of the deep learning face recognition logistics system.

2473-3636/21/$31.00 ©2021 IEEE
DOI 10.1109/DCABES52998.2021.00032

1) Data processing unit. The data processing unit is composed of an image processing server, and the image processing server has a built-in cohesive neural network model based on deep learning. The main function of the image processor is to use multiple images uploaded by the user to the image storage unit as a set of training data for the training of the face recognition model. The recipient video uploaded by the courier is processed as a test data set to predict the result of image sorting. When uploading the sorting result to the file module, the database storage unit uploads the sorting result to the data display layer.

2) Data storage unit. The data storage unit is composed of a file server and a database server. The file server mainly stores and saves the photo of the person uploaded by the recipient and the key frame filtering of the video uploaded by the courier, and uses them as a test data set. Next, sort these two types of photos. The pictures uploaded by users are used as the training data set for the face recognition of the convergent neural network. Use the image uploaded by the processor as the test chart of the cohesive neural network.

3) Data display layer. The main function of this layer is to display the facial recognition classification results based on the deep convergence neural network in express delivery. The courier compares the receipt of the goods based on the feedback information.

C. Logistics Signing Management System

When logging in to the management interface, you will see the user login option. You must enter the previously registered user account and then enter the password. The system background decides whether the user login or the administrator login is based on the permissions at the time of registration. If you forget the password you used when registering, you can click Forgot Password to get it.

The logistics sign-off system can be divided into two categories: shippers and users. Once the processor is connected to the interface, you can view the sender, order details for today's shipment, order number, content, and shipping address through the order details. If the goods have been delivered to the specified address, you can confirm that the recipient is the user. Then click Confirm Shipment.

After arriving at the designated receiving address, the courier must use the mobile phone to collect the recipient's face video, connect to the face recognition system, upload the collected video, and analyze it.

After connecting to the system, the courier selects the face recognition system, clicks the file selection button, and chooses to upload the video taken by the face. After selecting the file, click the face recognition button to perform face recognition. The system can basically perform face recognition in real time: below the photo, the user name and location of the person are displayed. The sender compares the returned user name with the recipient of the order details. If the comparison is successful, the sender will deliver the goods and click the order details page to complete the delivery.

III. Investigation and Research of CNN-based Face Recognition Technology in Smart Logistics System

A. Data Set

This article uses two sets of face-to-face data to train the network model. The two most reliable face data sets for face detection are the FDDB face data set and the WIDER face data set.

FDDB is a set of evaluation data created specifically for face detection and is maintained by the School of Computer Science at the University of Massachusetts. It is one of the world's leading face tracking and evaluation data sets. The total number of people is 2,375, and each photo has a detailed label on the face coordinates. These faces were taken in the field, very close to everyday application scenarios, such as rare poses, occlusion, low resolution, and out of focus.

WIDER Face is a large-scale face detection reference data released by the Chinese University of Hong Kong. Including more than 3,000 photos and nearly 40,000 faces. All these data sets are manually labeled and contain real scenes of various facial image changes, including occlusion, posture, stop, and lighting.

B. Preprocessing of Data Entry

In this article, we will choose WIDER Face as the sample practice set and FDDB as the sample test set. Build the network after practicing the candidate framework. The candidate frames created should be divided into positive samples and negative samples. In other words, take a face photo as a positive example. A photo without a human face serves as an example of the negative side. The separation between positive and negative samples should be based on the overlap ratio. It is a parameter of the target detection and evaluation system. The overlap ratio is the ratio of the sum and the intersection of the detection result and the Ground Truth box labeled in the training set. The fetching results here are displayed in the option box. The calculation is shown in Equation 1. The specific calculation is shown in formula 1:

$$IOU = \frac{Detectionr\,\mathrm{Re}\,sult \cap GroundTruth}{Detectionr\,\mathrm{Re}\,sult \cup GroundTruth} \quad (1)$$

Calculate the IOU values of all candidate boxes and Groud Truth Box, and use the candidate box with the largest IOU as a positive sample to ensure that each picture has at least one positive sample. In addition, the candidate box with an IOU greater than 0.7 is also used as a positive sample. Candidate boxes less than 0.3 are regarded as negative samples.

Use T to represent the positive sample, then T=TP+FN, and N to represent the negative sample, then N=FP+TN, and the accuracy rate is shown in formula 2:

$$Accuracy = \frac{TP + TN}{P + N} \quad (2)$$

IV. INVESTIGATION AND RESEARCH ANALYSIS OF CNN-BASED FACE RECOGNITION TECHNOLOGY IN SMART LOGISTICS SYSTEM

A. CNN's Face Recognition Technology Algorithm Detection Speed Comparison

This article compares CNN with several more classic algorithms, including Multi Task CNN and Joint Cascade's classic face detection methods, all of which are tested using the FDDB database evaluation method. In addition, the comparison of time and test results are shown in Figure 1.

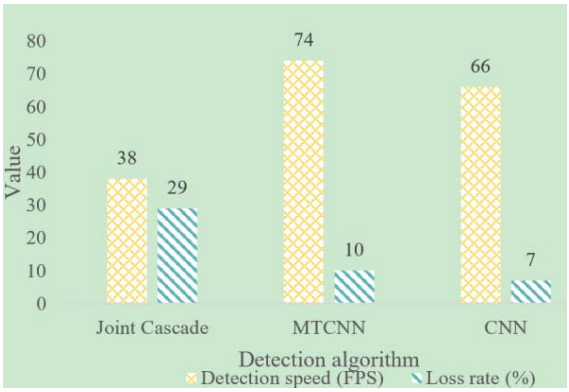

Figure 1. Algorithm comparison

The detection speed is expressed by FPS, that is, the number of frames transmitted per second. The higher the number of frames, the higher the algorithm detection speed. The improved CNN detection speed is uniformly controlled on the GPU (NVIDIA GTX1050). Compared with the three MTCNN methods Joint Cascade and Cascade CNN, CNN has the lowest loss rate. As shown in Figure 1, the detection speed is higher than Joint Cascade but lower than MTCNN, but it is sufficient to meet the needs of face-to-face systems.

B. Comparison of Correct Recognition Rate of CNN's Face Recognition Technology Algorithm

Because the database is an infinite choice of people, the recognition rate of some classic algorithms is not very high and cannot reach a satisfactory level. The detection rates of PCA (Principal Component Analysis), SVM (Support Vector Engine) and LBP (Local Binary Operation) are all lower than 50%. LBP can recognize effective faces under the condition of small rotation angle changes and uniform illumination, and it has certain robustness. However, the data range of FDDB exceeds the limit of LBP, so the recognition rate in the FDDB database is very low, less than 50%. Although SVM has the characteristic of approximating arbitrary functions, the characteristics of human faces in the database are complex and changeable. The general characteristics of PCA are not suitable for unlimited face environments, so the recognition rate is the lowest. The accuracy of science fiction (sparse filtering) is much higher than the first three algorithms, because it can dilute facial features to achieve optimized high-resolution features, and the recognition rate of global abstract features is just over 70%. Compared with the above DBN (Deep Belief Network), the recognition accuracy is very high, so advanced features can be removed.

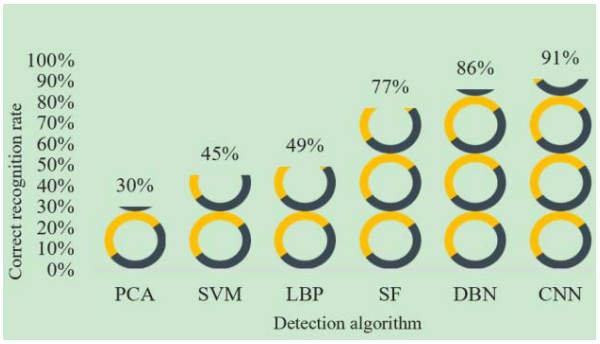

Figure 2. Recognition rate of various algorithms in LFW database

Comparing CNN with the above algorithm, as shown in Figure 2, it can be seen that CNN has the highest recognition rate. The recognition of DBN is also very high, but the loss of CNN is lower. Under infinite face conditions, an accuracy of 91% can be obtained, which shows that CNN can be applied to a face recognition system to achieve the desired effect.

V. CONCLUSIONS

As the most popular recognition technology at present, face recognition has a very wide application potential in real world applications due to its non-contact, convenient and other advantages. Especially in recent years, due to the rapid development of artificial intelligence technology, the rapid development of convergence neural network and face recognition technology has made great progress. This article mainly discusses the research on face recognition algorithms at home and abroad, and expounds the importance of face recognition in logistics. Analyze the feasibility and benefits of deep learning methods for face recognition in logistics. By comparing the pros and cons of feature recognition principles such as SVM, YOLO, SSD, CNN, etc., the improved CNN is finally selected as the key face recognition model in this article. The purpose of this article is to study the face recognition of the CNN model to improve the recognition accuracy and improve the detection rate, detection rate and accuracy.

REFERENCES

[1] Anna K. Bobak, Benjamin A. Parris, Nicola J. Gregory. Eye-movement strategies in developmental prosopagnosia and "super" face recognition[J]. Quarterly Journal of Experimental Psychology, 2017, 70(2):201-217.

[2] Rahim R , Af Riliansyah T , Winata H , et al. Research of Face Recognition with Fisher Linear Discriminant[J]. IOP Conference Series Materials Science and Engineering, 2018, 300(1):012037.

[3] Attwood A S , Easey K E , Dalili M N , et al. State anxiety and emotional face recognition in healthy volunteers[J]. Royal Society Open Science, 2017, 4(5):160855.

[4] Guo K , Wu S , Xu Y . Face recognition using both visible light image and near-infrared image and a deep network[J]. Caai Transactions on Intelligence Technology, 2017, 2(1):39-47.

[5] Min R , Kose N , Dugelay J . KinectFaceDB: A Kinect Database for Face Recognition[J]. IEEE Transactions on Systems Man & Cybernetics Systems, 2017, 44(11):1534-1548.

[6] Lu J , Liong V E , Wang G , et al. Joint Feature Learning for Face Recognition[J]. IEEE Transactions on Information Forensics & Security, 2017, 10(7):1371-1383.

[7] Peng C , Gao X , Wang N , et al. Graphical Representation for Heterogeneous Face Recognition[J]. IEEE Transactions on Pattern Analysis & Machine Intelligence, 2017, 39(2):301-312.

[8] Best-Rowden L , Jain A K . Longitudinal Study of Automatic Face Recognition[J]. IEEE Transactions on Pattern Analysis and Machine Intelligence, 2018, 40(1):148-162.

[9] Landi S M , Freiwald W A . Two areas for familiar face recognition in the primate brain[J]. Science, 2017, 357(6351):591.

[10] Grm K , ?truc, Vitomir, Artiges A , et al. Strengths and weaknesses of deep learning models for face recognition against image degradations[J]. Iet Biometrics, 2018, 7(1):81-89.

[11] Feng Q , Yuan C , Pan J S , et al. Superimposed Sparse Parameter Classifiers for Face Recognition[J]. IEEE Transactions on Cybernetics, 2017, 47(2):378-390.