Eurasia Journal of Science and Technology	ISSN: 2663-1024	Volume 2, Issue 2, pp 25-31	APR 2020

RESEARCH ON ATTENDANCE SYSTEM OF FACE RECOGNITION

Shengbing Hong , Wei Zhan, Jinhui She*

College of computer science, Yangtze University, Jingzhou, Hubei, 434023, China

Abstract

With the continuous development of computer vision technology, face recognition technology is widely used in identity authentication system. The main research content of this paper is the application of face recognition technology in the swipe card attendance system. We all know that most of the traditional swipe card attendance system is to swipe the electromagnetic card to sign in, which inevitably leads to the phenomenon of signing on behalf of others and forgetting to bring the magnetic card. In order to solve the inconvenience of traditional attendance system, in this paper, we focus on the research of a face recognition system of swiping card attendance. We only need to brush the face to punch in. Considering the disadvantages and low accuracy of traditional pattern recognition methods, this paper adopts deep learning face recognition technology. Firstly, through tensorflow deep learning framework, a separable convolutional neural network is built; secondly, face data sets are trained and classified, and relevant parameters are set to train a more suitable face model; finally, MFC visual programming integration process is used in order to realize the computer-side face recognition attendance system. The accuracy of face recognition technology in this paper can reach 98% in 1-to-1 recognition, which can basically meet the needs of attendance system.

Keywords: Face recognition; Deep learning; Face model; Attendance system; Tensorflow.

1 INTRODUCTION

In recent years, with the continuous development of Internet technology and its wide application in life, biometric technology is becoming more and more mature, among which face recognition technology is the most discussed. At present, face recognition technology is mainly used in the fields of check-in, access control, payment, identity authentication and so on, which brings convenience to people's life. So far, most of our enterprises or institutions use employee attendance systems are the way to brush electromagnetic cards, this way will not only brush the loopholes, but also with magnetic cards very inconvenient and will encounter card drop and forget card situation. Therefore, it is necessary to develop a face recognition card attendance system to achieve convenient and efficient purpose. After investigation, it is found that there is also this kind of face punch system in the market, but most of them adopt the traditional feature face recognition method. The disadvantages of this method may be affected by light, background difference and the suspicion of image or video impersonation.

At present, the research on face recognition mainly adopts the method of deep learning[1-4]. Aiming at the research of face recognition attendance system, it can obtain attendance information and understand the attendance situation in time, which can effectively improve the management efficiency. The attendance system in this paper can be applied to various places where attendance is completed independently. Compared with the attendance system in[6-14], the attendance system in this paper has strong generalization ability and is suitable for many scenarios. In this paper, the attendance system mainly has three functions: information login, face card typing and information storage. Face card printing is the main function of the system. That is, real-time face matching and recognition with the previously trained model to determine whether it is the same person; information storage is to save card information to the database. Experiments show that the face recognition system developed by this method can greatly improve the accuracy of recognition. The credit card attendance system developed by this method is not only efficient and fast, but also can effectively solve the disadvantages of the traditional credit card attendance system.

2 DISCUSSION ON THE EXPERIMENTAL PROCESS

We all know that the human brain can not only recognize the face in the picture, but also recognize the face in the video very accurately, because the video is actually a frame image sequence. When the brain reconfirms the true identity of the face, it can accurately find the face in the video; if we do not recognize a face, our brain will find face location in the video and constantly try to confirm the identity of the other person. The face card attendance system to be developed in this paper is similar to the process of brain recognition. First, the face database is established like the human brain. If it is the same as the current face object, then the next step, not continue to find. Therefore, face recognition can be divided into the following modules: face database construction, face detection, face recognition model based on depth learning, and the results are verified.

2.1 System Requirements Analysis And Framework Design

2.1.1 System master design

The methods of face recognition are: face recognition based on feature face algorithm, face recognition based on depth learning, geometric feature face recognition and elastic matching face recognition. The design idea of this paper is: to build the face database first, we need to obtain a large number of face images, that is, face data set. The main training data set used in this paper is open source data set LFW face database. The flow chart is shown in **Fig.1** below:

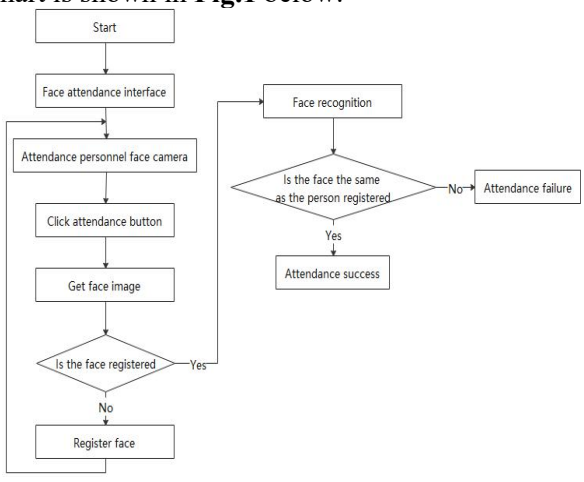

Fig. 1 Flow chart of face swipe card system

2.1.2 Functional design

The system has four main functions: 1, face initial registration function; 2, face management function; 3, face card attendance function; 4, attendance record function. first, the system should register the personnel information (name, id, face image, etc.) that needs to be checked in. this is the face registration function module. face management is responsible for viewing or modifying the personal information of related faces, such as name, id, etc.

2.1.3 Software design

The system mainly involves three modules in service, which are login module of personnel account information, face information input module and face recognition module. Its core module is the face recognition module. This module should fully learn and understand the related technology and knowledge of face recognition, constantly try the training of the model, adjust the parameters, and get a better model.

When calling the camera to take photos, it is necessary to use the face information input module, start taking pictures, and pass the data information and user related identity information into the database to save.

When the account login module is carried out, we need to call the information management module to obtain the personnel information, and then pass the read information into the personnel information management module, so that we can manage the designated personnel information.

2.1.4 Database design

Because this system mainly involves face recognition technology, it is not used in database, the main place to use database is the storage of personnel attendance information, only involves a database table.

Person table:

Table 1 Data base for personnel punch information

Attribute name	Data type	Remarks
Id	Int	Unique identifier, school number, ID number, etc
Name	Varchar (10)	Name of person
Picture	Varchar	Photo of the person

2.2 Data Acquisition And Processing

The face recognition part uses the SeetaFace face recognition algorithm, SeetaFace is the face recognition algorithm based on the C++ code developed by the teacher team of Shan Shiguang of the Chinese Academy of Sciences. In fact, the algorithm is a relatively complete face recognition system, which mainly includes three modules, which are three parts: face detection, location and recognition.

.2.2.1 Training model

Face recognition model of this system is mainly

trained by depth learning method. The approximate steps are as follows: using TensorFlow framework to build convolution neural network of depth learning, input training set to train face model, Test and verify the training face model. python language is used, and the specific project file directory is shown in **Fig.2** below:

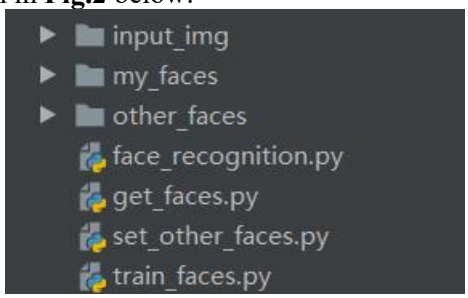

Fig.2 Catalogue structure of training face model project

First, And the other people we're using are LFW face data sets, this data set is commonly used in face recognition, it offers a total of 13827 face images, including 5749 people, stored in the input_img folder. To ensure consistency and ease of training, we use set_other_faces.py python program to grayscale and adjust the size. In addition, the main object of this program is myself, So I used the get_faces.py python program to call the camera to get 10000 face images of different poses in real time, and randomly adjusted the brightness and contrast, it also controls the size of the picture, I saved the picture in the my_faces folder. Then there's the training model, I am using train_faces.py procedures, Train me and others pictures before. Among them, the neural network used is the convolution neural network built with the TensorFlow framework, it is also a classic three-layer convolutional neural network, and using random methods to select test sets and training sets, A total of more than 23000 pictures were trained in about 20000, More than 2000 tests. Finally, the accuracy of 98% of my face training model, the loss rate is around 0.1, As follows: the train_faces.model in the diagram is the obtained model.

Fig.3 Face model file

After that, I carried out a real-time face recognition test on the model, using faces_recognition.py program in **Fig. 2**, which can use the camera to obtain the current face image to determine whether it is me. In my test, as long as my image can be recognized correctly, so use this model to identify themselves to achieve the desired results.

2.2.2 Face recognition

Face detection module SeetaFace Detection: the realization of this module is a face detection method which includes both traditional cascade structure detection method and depth learning of multi-level neural network. This kind of funnel cascade structure is designed for multi-pose face detection. This structure discards the rough part and tries to be concise, while balancing speed and precision. this FuSt cascade structure, as shown in **Fig.4** below, consists of multiple high-speed LAB cascade classifiers located at the top of various poses, followed by a multilayer perceptron (MLP) cascade structure with SURF functional features. finally, a candidate window for a unified MLP cascade structure, which is used to handle faces of various poses. The structure as a whole presents a funnel shape with upper width and lower width. From the top to the bottom, the classifiers at all levels and the features to be extracted are becoming more and more complex. Thus, the essential features of face can be preserved and the candidate window of non-human face features which are more and more difficult to distinguish from face can be excluded.

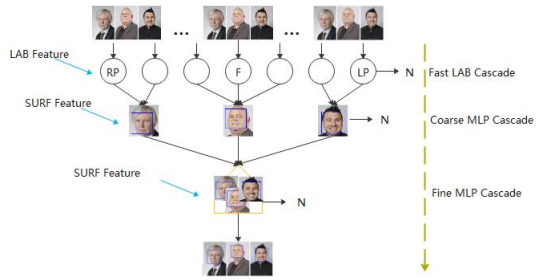

Fig.4 SeetaFace FuSt funnel-level connection diagram of face detection module

This funnel algorithm can quickly filter a large number of non-human face windows and then use complex structures to screen the required faces layer by layer. **Fig.5** shows that even blocking local face images with both hands can detect face regions.

Fig.5 SeetaFace face detection

Facial feature point location module SeetaFace Alignment: facial feature point placement (facial registration) in many facial analysis tasks (facial recognition, Facial expression recognition, Facial animation synthesis, etc.) plays a very important role. Because of posture, Facial expressions,

Lighting, the effect of occlusion, face alignment in real scenes is a very difficult problem. Formally, the problem can be seen as a complex nonlinear mapping between facial appearance and facial shape. To that end, SeetaFace Alignment use a coarse-to-fine autoencoder network, CFAN) to solve this complex nonlinear mapping process. CFAN cascaded a multilayer stack autoencoder network, as shown in **Fig.6**. each level characterizes a partial nonlinear mapping of facial appearance to facial shape. The specific process is to input the facial area obtained by the facial detection module. A first-level auto-encoder network can quickly estimate approximate face shape from S0. low-resolution version Next, Increase the resolution of the input facial image, extracting local features of each feature point location S0 the current facial shape (correspondingly improving resolution), then input to the next level self-encoder network to further optimize the results. Similarly, by cascading multiple stack self-encoder networks, Face registration results can be gradually optimized with higher and higher resolution face images.

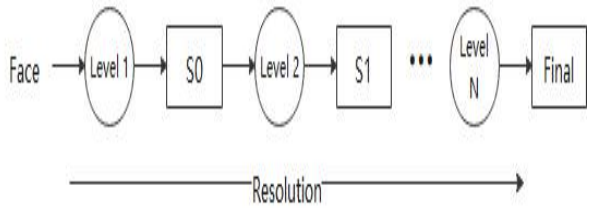

Fig.6 Schematic illustration of face alignment method

CFAN method is used in this facial feature point location module, which needs to be accurately located to the five key feature points of the face, consisting of two eye center points, nose tip points and two mouth corner points. A training set contains more than 23000 face images. In order to get a better training model to prevent the loss of accuracy, we try to use machines with GPU and high-performance processors and graphics cards. If the situation is not allowed to use the network high-performance server for training.

Fig.7 is an effect diagram obtained by SeetaFace Alignment the location of feature points of the same person in different states and positions. I found that after many tests, different expressions, head down, different face deflection angle can be accurate and effective positioning. And for people wearing glasses, the test can also be carried out, can also get the location of the face area.

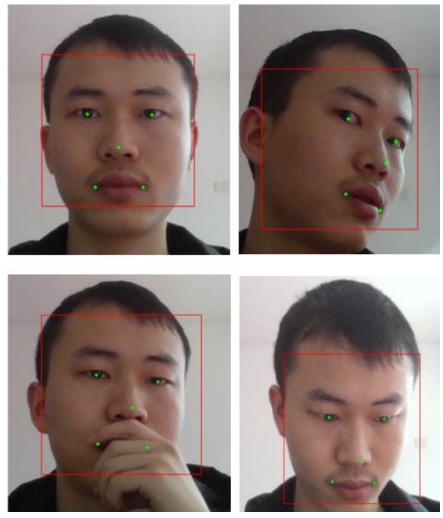

Fig.7 SeetaFace Face alignment effects

Face feature extraction and comparison module SeetaFace Identification: face recognition is basically calculating the similarity of faces in two images. One enters the system at the registration stage (similar to the human acquaintance process) and the other at the recognition stage (the identification process at goodbye). Therefore, after completing the above two steps of facial detection and facial registration, the automatic facial recognition system enters the third core step of facial feature extraction and comparison: face feature extraction and comparison. This stage is also the most advanced module after the depth learning is more mature. currently, the best facial recognition algorithm is to use convolutional neural networks (CNN) to train feature extractors (i.e., function F in **Fig.8**).

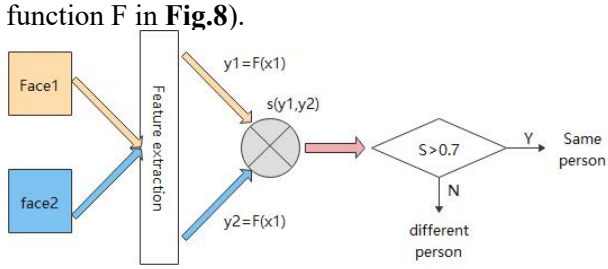

Fig. 8 Flowchart of Face Recognition System

Just as shown in **Fig.8** above, if picture 1 is a registered face image and picture 2 is a face image acquired during recognition, After the first two steps of face detection and feature point location processing, the feature map x1 and x2, input the two feature maps into the feature extractor, that is, the trained model.As for the selection of threshold, according to the results of face feature point location model, the general threshold given by us in high precision face recognition scene is 0.62, and we also consider a 1:1 and 1:1: N scene, which is a human card contrast. This system is actually the first application scenario, that is ,1:1, so we set the threshold to 0.7, when the similarity is greater than 70, we think it is the same person, and when the

similarity is less than 70, we think it is not the same person.

2.3 Visual Integration Of Systems

The system integrates the three core modules of the SeetaFace algorithm, namely, SeetaFace Detection 、SeetaFace Alignment and SeetaFace Identification, and integrates the MFC visual programming method into a card attendance system based on face recognition.

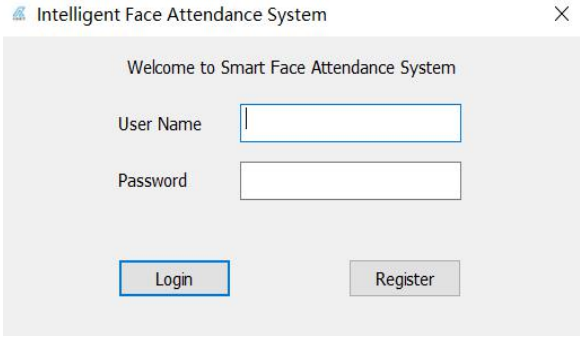

Fig.9 Main page of face recognition attendance system

As shown in **Fig.9** above, this system uses the results of the previous steps to integrate the final face recognition system through MFC visual programming. The page is entered by user name and password, and there are two buttons for login and registration. What this paper envisions is that the new face enters the face and other related information through the registration function. The registered face enters the main page of the card to check the attendance and determine whether the attendance person is himself.

3 EXPERIMENTAL RESULTS

(1) Face registration module: this module is mainly divided into two steps: face registration and face entry.

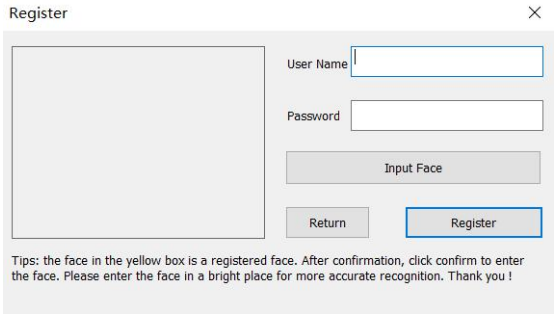

Fig.10 Registration page of face recognition card system

As shown in **Fig.10** above, the face registration page has two input boxes: name and password. Click the face entry button to open the camera on the left (**Fig.11** below). Click the confirm entry button to get the face picture in the video. The system passes these data into the database to save. If you do not enter the face, you will be prompted not to get the face picture, please re-enter, and if you do not enter the name and password, you will also be prompted to enter the password and user name. Next, clicking the return button will go back to the login page. Then according to the previously registered account and password can log in to the system, if the account or password input error, the system will also prompt the corresponding error, until the successful completion of login.

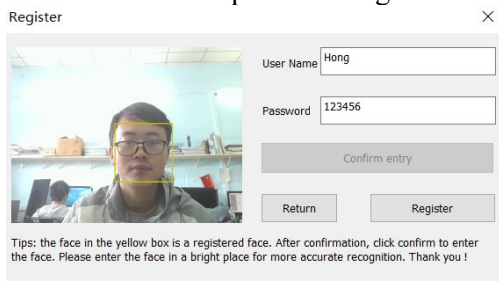

Fig.11 Face Recognition Card System Face Entry Page

(2) Face Attention module: this module mainly designs face punch and punch result two steps.

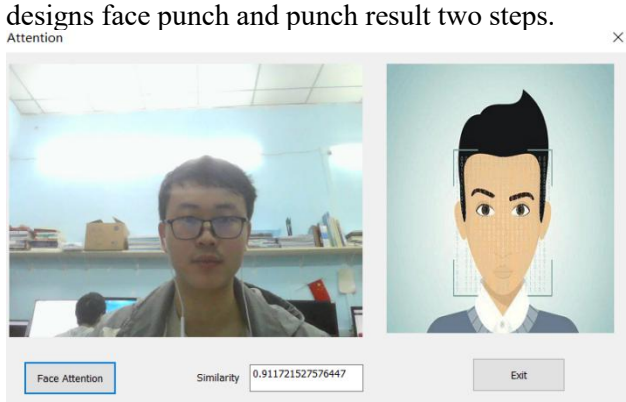

Fig.12 Punch cards for face recognition

As shown in **Fig.12** above, the face punch module has a camera call window to obtain the current face image, and a face punch button. This paper designs a face punch button. The system will obtain the current image and the previous registered image, and display the results in dialog box. In the similarity column, the recognition rate of the current face recognition will be displayed, that is, by obtaining the current face image, when clicking the punch button, the current face image incoming face recognition algorithm matches the face image saved by the previous registration database. If 90% recognition rate is reached, it is judged to be the same person. If 90% recognition rate is not the same person or external environment, return card failure, please try again. Clicking the cancel button will exit the entire system.

4 EXPERIMENTAL ANALYSIS

The development of this system mainly involves two aspects: training face model, face recognition; in training face model, the system only uses CNN training network based on TensorFlow framework; and face recognition adopts SeetaFace recognition algorithm. Specifically, the network used in the face feature extraction module is the neural network described in the[9] VIPLFaceNet: a DCNN. containing 7 convolution layers and 2 fully linked layers which is directly modified from the AlexNet network designed by Alex Krizhevsky et al. in 2012.As shown in table 2 below, Compared to AlexNet, VIPLFaceNet split the 5 x5 convolution kernel into two layers of 3 x3 convolution kernel, It increases network depth but does not increase computation; VIPLFaceNet also reduce the number of kernel per convolutional layer as well as the number of nodes in FC2 layer. Meanwhile, by introducing Fast Normalization Layer (FNL), Accelerated VIPLFaceNet convergence, and to a certain extent, the generalization ability of the model is improved. Tests show that, In the same training set, VIPLFaceNet the recognition error rate on the LFW test set is 40% lower than the AlexNet, and the training and test time were 20% and 60% of the AlexNet, respectively.

Table 2 VIPFaceNet Comparison of Network and AlexNet Network Structures

AlexNet	VIPFaceNet
Conv1: 96×11×11, S: 4, Pad: 0	Conv1：48×9×9, S：4,Pad：0
LRN	—
Pool1：3×3, S：2	Pool1：3×3, S：2
Conv2:256×5×5, G: 2, S:1, Pad:2	Conv2：128×3×3, S：1,Pad：1
LRN	—
—	Conv3：128×3×3, S：1,Pad：1
Pool2：3×3, S：2	Pool2：3×3, S：2
Conv3：384×3×3, S：1,Pad：1	Conv4：256×3×3, S：1,Pad：1
Conv4: 384×3×3, G:2, S:1, Pad:1	Conv5：192×3×3, S：1,Pad：1
—	Conv6：192×3×3, S：1,Pad：1
Conv5: 256×3×3, G:2, S:1, Pad:1	Conv7：128×3×3, S：1,Pad：1
Pool3：3×3, S：2	Pool3：3×3, S：2
FC1,4096	FC1,4096
Dropout1：dropout ratio：0.5	Dropout1：dropout ratio：0.5
FC2,4096	FC2,2048
Dropout2：dropout ratio：0.5	Dropout2：dropout ratio：0.5
FC3, Number of training classes	FC3, Number of training classes

Overall, the system basically achieved all the purposes of the study, to achieve the desired results. Technically, the recognition efficiency of the SeetaFace recognition algorithm used in this system is relatively high. His recognition on the LFW data set has reached 97.1% accuracy. For this experiment, this is already a relatively high recognition rate. It is found that the algorithm is greatly affected by illumination, background difference, facial expression, occlusion, etc. At that time, if I use both hands to block his eyes, he will not recognize, and the scene used in this system is the place of credit card attendance, if the recognition rate is not high, it will affect the actual utility. Therefore, it is necessary to deepen the research in improving the face recognition algorithm, select a good face recognition algorithm, and improve the recognition accuracy of the system; From the functional point of view, the system is a credit card attendance system, the function required is not only a part of face recognition, but also the function of viewing attendance records and managing attendance system. This needs to take into account database records of personnel information and administrator rights and other issues. Therefore, the system to better work, but also need to continue to update and improve.

5 CONCLUSIONS

How to use the TensorFlow framework to build neural network and how to use the built network to train the model is introduced in this paper. As for face recognition technology, this paper uses a SeetaFace face recognition engine, which includes face detection module, face feature point location module and face feature extraction and contrast module. The system is developed in C++ language to improve the efficiency of the system, and the method of deep learning is introduced into the face recognition system to improve the accuracy of recognition, and the MFC visual programming technology is applied. The developed system basically meets the requirements of the experiment and can carry out simple face card attendance. This study will also provide a reference for the application of face technology in attendance scenes in the future.

ACKNOWLEDGMENT

This research is supported by the project "Research and Development of New Methods in Urban Management of UAV Visual Data Deep Learning and Identification Technology "(No.2018024) of Jingzhou Science and Technology Development Program in 2018.

REFERENCES

[1] Xing Jin, Wenyun Sun, Zhong Jin. A discriminative deep association learning for facial expression recognition. International Journal of Machine Learning and Cybernetics, 2020, Vol.11 (3), pp.779-793.

[2] Image conditions for machine-based face recognition of juvenile faces[J]. Ching Yiu Jessica Liu,Caroline Wilkinson. Science & Justice. 2020.

[3] Fahima Tabassum,Md. Imdadul Islam,Risala Tasin Khan,M.R. Amin. Human face recognition with combination of DWT and machine learning[J]. Journal of King Saud University - Computer and Information Sciences,2020.

[4] Atoum Y, Liu Y, Jourabloo A, et al. Face anti-spoofing using patch and depth-based cnns[C]//2017 IEEE International Joint Conference on Biometrics (IJCB). IEEE, 2017: 319-328.

[5] Xin Liu, Meina Kan, Wanglong Wu, Shiguang Shan, Xilin Chen, "VIPLFaceNet:An Open Source Deep Face Recognition SDK," Frontier of Computer Science, vol. 11, no. 2, pp. 208–218, 2017.

[6] Long Haiqiang, Tan taizhe. Research on face recognition method based on deep convolution network algorithm [J]. Computer simulation, 2017,34 (1): 322-325.

[7] Chen Lichao, Zhang Xiuqin, pan Lihu, et al. Research on face recognition algorithm in coal mine attendance system [J]. Industrial and mining automation, 2015,41 (4): 69-73.

[8] Perona P, Malik J. Scale-space and edge detection using anisotropic diffusion[J]. IEEE Transactions on pattern analysis and machine intelligence, 1990, 12(7): 629-639.

[9] Weickert J, Romeny B, Viergever M A. Efficient and reliable schemes for nonlinear diffusion filtering[J]. IEEE transactions on image processing, 1998, 7(3): 398-410.

[10] Wu Yao, Qiu weigen. Face recognition based on improved deep convolution neural network [J]. Computer engineering and design, 2017,38 (8): 2246-2250.

[11] He Changting. Research and implementation of face recognition method in class check-in system [D]. 2018.

[12] Liu Sheng. Design and implementation of classroom face brushing and checking in system of Sichuan Jianyuan [D].

[13] Hou Ruifa, Yang Xiong, Chen Weida, et al. Class attendance system based on face recognition technology [J]. Network security technology and application, 2019, 222 (06): 49-50.

[14] Tang Wenjun, Peng Li, Xi Bowen. A class attendance system based on smart phone [J]. Computer age, 2019, 320 (02): 22-26.

[15] W. Cui, W. Zhan, J. Yu, C. Sun and Y. Zhang, "Face Recognition via Convolutional Neural Networks and Siamese Neural Networks," 2019 International Conference on Intelligent Computing, Automation and Systems (ICICAS), Chongqing, China, 2019, pp. 746-750, doi: 10.1109/ICICAS48597.2019.00161.

[16] Han Wei, Inomjon Ramatov, Cui Wanxin, et al. An overview of deep learning target detection algorithms based on candidate regions [J]. Journal of Yangtze University (self SCIENCE EDITION), 2019,16 (5): 108-115.

(Diptera: Trypetidae) Detection and Statistics. Insects 2020, 11, 565.

[17] Chenfan Sun, Wei Zhan, Jinhiu She, Yangyang Zhang, "Object Detection from the Video Taken by Drone via Convolutional Neural Networks", Mathematical Problems in Engineering, vol. 2020, Article ID 4013647, 10 pages, 2020. https://doi.org/10.1155/2020/4013647.

[18] Zhang, Z.; Zhan, W.; He, Z.; Zou, Y. Application of Spatio-Temporal Context and Convolution Neural Network (CNN) in Grooming Behavior of Bactrocera minax

[19] Cui, W. Zhan, J. Yu, C. Sun and Y. Zhang, "Face Recognition via Convolutional Neural Networks and Siamese Neural Networks," 2019 International Conference on Intelligent Computing, Automation and Systems (ICICAS), Chongqing, China, 2019, pp. 746-750, doi: 10.1109/ICICAS48597.2019.00161.