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Research and Application of Multi-source Data Fusion Identity Authentication System

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***Abstract*——Aiming at the problem of low efficiency and time-consuming of the traditional college attendance sign-in method, an attendance system based on face recognition, wireless network verification, fingerprint and voice verification was proposed and designed. This design splits the attendance system into four functions: wireless network list acquisition verification, face recognition, voice verification, fingerprint acquisition, and sign-in record storage.Based on this, a database for storing data and a graphical interface are designed to achieve The function of the time and attendance system.**

Keywords: multi-source integration, time and attendance system, identity authentication.

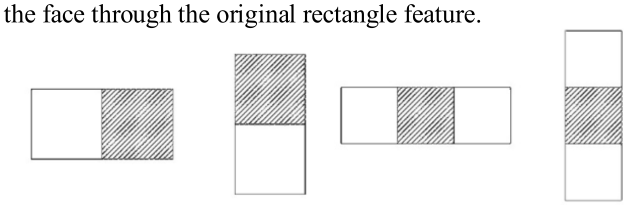
I. INTRODUCTION

In recent years, with the popularization of higher education, major universities continue to expand enrollment to a certain extent, resulting in a shortage of teaching resources and a large workload. In the course of university education and student work management, attendance is an important content. At present, Chinese colleges and universities mainly use manual attendance or swipe attendance in their daily attendance. Although they can play a role, they also cause many problems, such as: card punching, check-in, teachers fail to recognize students, and time-consuming attendance. . This has led to the phenomenon of students skipping classes and making fakes in their work attendance. Therefore, the traditional way of attendance by name is not suitable for the attendance needs of colleges and universities. Therefore, the development of an identity recognition system for multi-data fusion of face recognition and speech recognition for students meets the actual needs of current teaching.

This project is a campus attendance system that integrates face recognition, wireless network information, voice, and fingerprints.

II. RELATED WORK

Face recognition technology is mainly subdivided into several steps. (1) Search for the face area range: Use the image captured by the camera as input to determine whether there is face information in the current image. If the face is in the specified area range, mark it. (2) Extraction of facial features: Perform feature analysis and localization on the marked faces, and finally generate a face model. (3) Confirmation of face detection: Based on this model, it is detected whether it is a real human body rather than a picture or video, and compared with the server model to complete the confirmation work. Haar feature analysis, which is rectangular feature analysis, as the input of the Adaboost algorithm The Adaboost algorithm calculates and judges the face area, extracts the face part of the entire image, and discards the non-face part. The human face has some significant edge features, and the rectangular features are more sensitive to these edge contours. It's similar, it will be darker than the mouth. The rectangular feature can more easily lock the main areas of the face such as eyes and mouth. The two-adjacent and three-adjacent rectangles represented by the A[-1, 1] and B[-1, 1, -1] operators in the rectangle feature, as shown in Figure 1, locate the main area of the face through the original rectangle feature.



(a) Two adjacent rectangles (b) Three adjacent rectangles
Figure 1 Original matrix features

When performing face detection, both the running speed of the algorithm and the accuracy of the algorithm need to be considered. After verification using the QR code, the target sample registered by the logged-in user on the server can be obtained, and then detected by using the rectangular area as the characteristics of the logged-in user. After the Haar feature acquisition is completed, the Haar feature value needs to be calculated. In order to improve the detection speed, it is a common method to calculate the feature value using the integral graph. Define its integral graph ii (x, y) as

$$ii(x, y) = \sum_{x' \le x, y' \le y} i(x', y') \tag{1}$$

That is, at the (x, y) position, the pixel in the corresponding integral map is the sum of all pixels in the upper left corner of the position.

Each row calculates z (x, y) recursively. Each row calculates z first. After the calculation, ii (x, y) is calculated in each column. In this way, the integral graph can be calculated as shown in Equations 2 and 3, where z (x, -1) =0, ii (-1, y) =0, s (x, -1) =0, ii (-1, y) = 0 is the initial value. i (x′, y′) is the "original image" at the point (x′, y′), which is the color value of this point; for grayscale images, the value is 0~255. For color images, you can first convert them to grayscale values according to the face color space

$$ii(x, y) = ii(x-1, y) + z(x, y) \tag{2}$$

$$z(x, y) = z(x, y-1) = +i(x, y) \tag{3}$$

i (x′, y′) is the "original image" at the point (x′, y′), which is the color value of this point; for grayscale images, the value is 0~255. For color images, you can first convert them to grayscale values according to the color space of the face.

Among them, z (x, y) is the sum of all the original images in the point (x, y) and its upward direction in the y direction, which is called "column integral sum", which can be defined as: s (x, 0) = 0, ii (0, y) = 0

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The Adaboost algorithm calculates and judges the area of the face, and after extracting the face parts, trains a weak classifier for each sample of the face parts extracted, and the proportion of the samples in each iteration needs to be determined by the previous time , The proportion of the i-th sample is determined by the i-1th sample. Each time the weight value of the misclassified sample is increased, this can highlight the misclassified sample and get a new sample distribution and train to obtain a new weak classifier. The iterative algorithm used by Adaboost is simply to re-evaluate the training samples and then perform loop training. The initial sample weight settings are consistent and the final enhanced strong classifier.

A、 Biopsy

A living body detection method based on interactive random actions is used to prevent signers from posing as photos, videos, etc. The identified person needs to complete some specified actions through the instructions given by the system, such as blinking, mouth opening, shaking his head, etc. This method of living body detection based on interactive random actions is to detect, locate, track and extract features of human faces, and then judge whether the correct actions have been made according to the system requirements. It is necessary to ensure that the real-time action of the face can be detected to complete the detection, tracking and alignment of the recognized person's face; at the same time, the action instruction is issued to the user within the specified time, and the recognized person's authentication action sequence is different, so as to maximize Avoid the possibility of biopsy being compromised.

Algorithm implementation: First, the position coordinates of the face are obtained, and the position coordinate information of the face in the image is detected using the AdaBoost face detector. Then use the face alignment algorithm in this area to obtain the feature point coordinates of the key points of the facial features:

Extract SIFT features or HOG features of a given feature point Pi ∈ P:

$$\mathrm{F}(p^{0}+\Delta p)=\| H(p^{0}+\Delta p)-H(p^{*})\| \tag{4}$$

Among them, P0 is the initial coordinate of the feature points of the facial facial features key points automatically extracted by the algorithm, P* is the manually calibrated feature point coordinate of the actual facial facial features key points, ΔP is the offset of P0 and P*, H SIFT feature extraction function. After the feature points are determined, the facial poses can be estimated through these feature points. For example, for the eyes, use the inner corner of the eye as the starting point 1, respectively number the feature point position 1 inner corner of the eye, feature point position 2 above the eye, feature point position 3 outer corner of the eye, feature point position 4 outer corner of the eye, calculate the width and height of the current eye to determine the eye status:

$$J(p)=\frac{\| p_1(x)-p_3(y)\|}{\| p_2(y)-p_4(y)\|} \tag{5}$$

B、 Fingerprint recognition algorithm based on correlation coefficient

A fingerprint identification algorithm for a specific population completed by using correlation coefficients, and for this algorithm, the scheme implemented by ASIC and the verification result of FPGA are given. In signal analysis, the correlation coefficient is often used to determine the similarity of two signals. Assuming that x (t) and y (t) are respectively energy-limited signals in two continuous-time systems, their correlation coefficients are determined by equation

$$\rho_{xy}=\frac{\int_{-\infty}^{+\infty} x(t)y(t)dt}{\int_{-\infty}^{+\infty} x^2(t)dt \int_{-\infty}^{+\infty} y^2(t)dt]^{1/2}} \tag{6}$$

If |ρxy|=1, then the signals x (t) and y (t) are completely linearly related; if |ρxy|=0, then the signals x (t) and y (t) are completely linearly independent; if between In time, the similarity between signals can be determined according to their size. The same concept can be introduced into discrete-time systems. Assuming that x (n) and y (n) are two signals of a discrete-time system, the effective range of their subscripts is [0, n-1], and E (x) and E (y) are used to denote x (n) and y DC component of (n), then the correlation coefficients of x (n) and y (n) can be determined by equation

$$\rho_{xy}=\frac{\sum_{n=0}^{N-1}[x(n)-E(x)]\cdot[y(n)-E(y)]}{\left\{\sum_{k=0}^{N-1}[x(k)-E(x)]^2\cdot\sum_{l=0}^{N-1}[y(l)-E(y)]^2\right\}^{\frac{1}{2}}} \tag{7}$$

Assuming that the collected fingerprint images are digitized, the process of fingerprint matching is essentially comparing the similarity of the two fingerprint images. According to the discussion of the correlation coefficient in 2.1, the correlation coefficient can be used as a criterion for fingerprint matching. The fingerprint image is a two-dimensional digital image, and its data is stored as a two-dimensional array x (m, n). Expand the calculation of correlation coefficient to two dimensions. Assuming that x (m, n) and y (m, n) are two two-dimensional digital image signals, their correlation coefficients can be determined by equation

$$\rho_{xy}=\frac{\sum_{i=0}^{M-1}\sum_{j=0}^{N-1}x(i,j)y(i,j)-\sum_{k=0}^{N-1}\sum_{l=0}^{N-1}x(k,l)\cdot\sum_{m=0}^{N-1}\sum_{n=0}^{N-1}y(m,n)}{\sqrt{\left[\sum_{p=0}^{N-1}\sum_{q=0}^{N-1}x^2(p,q)-\left(\sum_{r=0}^{M-1}\sum_{s=0}^{N-1}x(r,s)\right)^2\right]\cdot\left[\sum_{u=0}^{M-1}\sum_{v=0}^{N-1}x^2(u,v)-\left(\sum_{g=0}^{M-1}\sum_{h=0}^{N-1}x(g,h)\right)^2\right]}} \tag{8}$$

If the two fingerprint images are identical, then |ρxy|=1. But in fact, even if the two images come from the same fingerprint, due to the difference in the direction or the degree of pressing at the time of collection, it may not be exactly the same. Therefore, when judging, first determine a threshold th, when the correlation coefficient ρxy≥th, it indicates that the two images are consistent, otherwise, it indicates that the two images do not match.

In order to ensure the quality of fingerprint images, the fingerprint collection environment is required to be consistent, including the collection background and the collection direction. The fingerprint verification algorithm based on correlation coefficients does not preprocess fingerprint images in order to facilitate hardware implementation. But considering the inevitability of fingerprint translation, it must be considered when calculating the correlation coefficient. Considering the influence of translation factors, it is assumed that the image y is superimposed on the image x, so that the pixels (a, b) of the image x and the pixels (0, 0) of the image y coincide, namely

$$\begin{cases} x_0(m,n) = x(a+m, b+n) & 0 \le m \le M_0 - 1 \\ y_0(m,n) = y(m,n) & 0 \le n \le N_0 - 1 \end{cases} \quad (9)$$

In the formula, M0 and N0 represent the height and width of the overlapping parts of the image x and y, respectively. Then substitute (3) to calculate. It should be noted that for two images to be translated multiple times, the correlation coefficient is calculated, and the largest value is taken as the final correlation coefficient.

C、 Speech Recognition

T The acoustic model in the context of smart devices is shown in Figure 1.

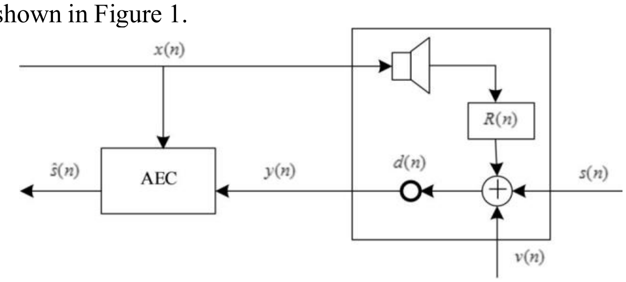

Figure 1 Acoustic model in the context of smart devices

BLSTM (Bidirectional Long Short-term Memory) refers to a bidirectional long short-term memory neural network, which is currently actively used in automatic speech recognition to implement acoustic modeling activities. The basic structural unit of BLSTM is shown in the figure below, from which we can see that there are three gate structures of input gate, forget gate and output gate.

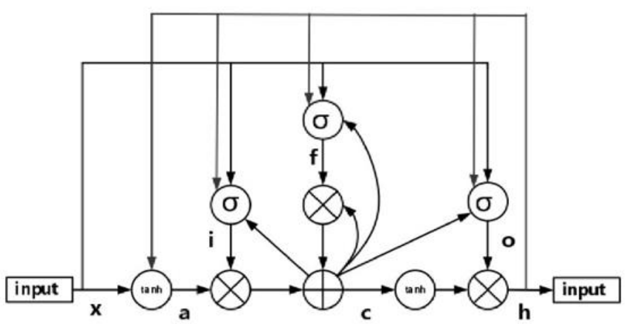

Figure 2 BLSTM (Bidirectional Long Short-term Memory)

i Input gate f Forget the door o Output gate h Hidden layeroutput a Central incentive σ Excitation function

Combined with the basic structural unit of BLSTM to achieve the goal of accurately calculating various structural parameters, a scientific and feasible calculation method is required, which is:

$$i_t = \delta(w_{xi}x_t + w_{hi}h_{t-1} + w_{ci}c_{t-1} + b_i) \quad (10)$$

BLSTM neural network is used as a learner. As shown in the figure, it contains two unidirectional long short term memory (LSTM) neural networks [23]. LSTM is a type of Recurrent Neural Network (RNN) Variants can solve the defects of traditional RNN gradient disappearance and explosion. It introduces a gating mechanism in the memory unit, which can selectively retain the amount of context memory, reduce network depth and alleviate gradient disappearance.

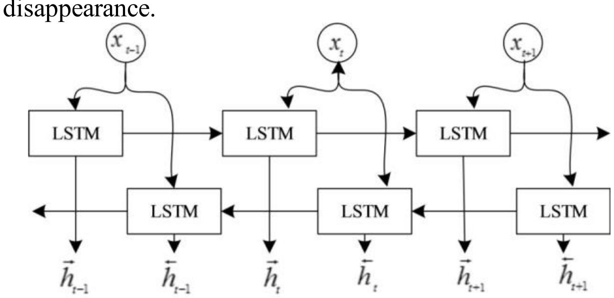

Figure 3 BLSTM neural network

D、Hotspot check-in

WiFi technology is a mature wireless communication technology. In a wireless network, the communication between the two devices can be carried out in a direct manner, or under the coordination of a base station (Base Station, BS) or access point (Access Point, AP). Compared with other wireless communication technologies, WiFi technology has the advantages of high transmission rate, strong signal strength, and short transmission time. Therefore, it is feasible and reasonable to introduce WiFi positioning technology into the check-in system.

The mobile phone sign-in system based on WiFi hotspots is mainly composed of mobile phone WiFi hotspots, mobile phone clients and servers of sign-in personnel. The mobile phone WiFi hotspot is used to provide WiFi hotspots and obtain the check-in information of the check-in staff; the check-in staff mobile client is used for check-in, and the server is used to store the check-in staff's mobile phone MAC address, check-in location and other information. The Wi-Fi hotspot-based mobile phone check-in system uses smart mobile terminals as Wi-Fi hotspots for the mobile phone access of the check-in personnel, and under the WiFi connection, quickly locates and detects the mobile terminal MAC address to complete the check-in function. It is a set of mobile Internet-based models The sign-in personnel under the sign-in management system platform can perform real-time comprehensive management of the attendance status of the sign-in personnel. Each mobile phone has a unique and unique MAC address, so the system uses the mobile phone MAC address as the unique identification of the sign-in, which can well prevent the sign-on phenomenon between the sign-in personnel. The MAC address of the mobile phone is the network card address of the mobile phone, that is, the ID number of the mobile phone network card. The MAC address is also known as the physical address and hardware address. It is used to define the location of the network device. It consists of a string of English characters plus numbers, and It is globally unique. The MAC address is generally 48 bits in length, and is usually expressed as 12 hexadecimal numbers. Each two hexadecimal numbers are separated by a colon. For example, 03:03:30:3A:3B:3C is a MAC address. The first 6 hexadecimal numbers 03:03:30 represent the number of the network hardware manufacturer, and the last 3 hexadecimal numbers 3A:3B:3C represent the series of a network product (such as a network card) manufactured by the manufacturer number. The system will collect the MAC address of the mobile phone of each person who signs in in advance, and map and bind it with the information of the person signing in, so that the sign-in management module can perform comparative analysis. As WiFi positioning technology matures, application systems based on WiFi positioning technology have also rapidly developed, enabling application systems to make better use of existing infrastructure without adding additional hardware equipment. Therefore, WiFi positioning technology It has the advantages of low price and easy operation, and is widely used. The check-in system uses WiFi positioning technology to obtain the location of the checked-in mobile phone, which can improve the accuracy of check-in. Because WiFi hotspots are ubiquitous in the current society, basically every location can receive 3~5 AP (Access Point) signals, and the location of WiFi hotspots is generally fixed and rarely changes, therefore, storage around the sign-in place The signal strength RSSI and AP location information sent by each AP, using RSSI for indoor positioning is feasible. The specific steps are as follows:

(1) Create a location database on the data server, and divide the positioning area into several grids. If the grid interval is too large, it will affect the positioning accuracy. If it is too small, it will increase the database load, and it is not conducive to positioning. 1~2m, the position sampling point interval is 1m.

(2) At a specific location, collect the signals of the fixed AP around the sign-in location, and record its MAC address, RSS, and location information on the location database in the format (X, Y, Name, MAC, RSS), where, X , Y indicates the coordinates of a specific location, RSS indicates the signal strength, MAC indicates the physical address of the AP, and Name indicates the logical name of the AP.

(3) Collect the signal strength and MAC address of the mobile phone WiFi hotspot and the sign-in person, and compare and analyze the measured data with the data in the location server through the K nearest neighbor matching algorithm to estimate the mobile Wi-Fi hotspot and the sign-in person. The location of the phone.

Check-in personnel check-in is effective mainly by determining whether the distance between the check-in phone and the WiFi hotspot is within the effective distance, and the distance calculation uses the Euclidean formula.

WiFi hotspot m_w Euclidean distance， m_i The coordinates are (x_i, y_i)， m_w The coordinates are (x_w, y_w),$disw$Indicates setting the effective distance standard for sign-in ， Distance $dis(m_i, m_w) = \sqrt{(x_i - x_w)^2 + (y_i - y_w)^2}$,if $dis(m_i, m_w) \leq disw$ It means the sign-in is successful; otherwise the sign-in fails

needs to be improved, its performance in the experiment is better than other algorithms' recognition accuracy, which proves the enhancement effect of this improved method and its high research improvement value.

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