Application Research of Face Recognition Technology in Smart Campus

Xiang Zhou¹

¹ School of Software, Nanchang University, Nanchang, China

Abstract: Promoting the degree of campus informationization has become an important part of the construction of smart campus. Face recognition, with its uniqueness and lifelong invariance, has natural security advantages and practical advantages in the application of smart campus, but it also has the disadvantages of high equipment cost and data leakage risk. The face recognition technology can be used to build safe educational environment, create convenient business processes and develop personalized technology service in the construction of smart campus. This paper designs and implements a dormitory management system based on face recognition. The test results show that the use of face recognition technology as a source of information collection for people entering and leaving dormitory area greatly improves the management efficiency and ensures the accuracy and reliability. The application of face recognition in campus management system will break the traditional mode of teachers and students’ work and life, and become an important part of smart campus.

1. Smart campus and face recognition technology

1.1 Smart campus

Smart campus refers to the intellectualized teaching, learning and living environment which integrates teaching, scientific research and service on the basis of internet and through various application system. It takes cloud computing and other network technologies as a link, and organically combines humanities with mechanical equipment. In this way, the trivial records of school daily work will be presented to the leadership in the form of big data to help the leadership to guide decision-making. Through the establishment of smart campus, colleges and universities can realize the comprehensive information service platform, build a safe and flexible network platform combining hardware and software, and provide reliable technical support for teaching and educational administration work in colleges and universities. At the same time, the use of man-machine cooperation to achieve smart monitoring of campus environment management, a comprehensive and detailed analysis of school teaching, educational administration and other work, and the formation of teaching data, for the management of colleges and universities to provide strong and accurate data, provide a reference for management. Integrating the local area network, wired network and sensor network into a perfect whole, supplemented by the use of information diversification platform, an integrated network system will be built for colleges and universities, and all related work will be operated as a whole. It shows a comprehensive and intellectualized management environment for teachers and students in the whole school. College administrators can apply student status management, teacher management and smart Course scheduling in smart campus. At the same time, students can experience online learning experience such as examination, course selection and self-learning. Moreover, the smart campus can collect the big data of teaching and teaching, and the management level of the school can be further improved by analyzing.
the big data. In order to meet the needs of teachers and students to the greatest extent, a single popular service is not possible. Smart campus should be able to create personalized service that meets everyone's needs of teachers and students.

1.2 Face recognition technology
Face recognition is a kind of biometric recognition technology, which usually collects human face image by camera or directly analyses data information containing human face image, and uses computer face recognition algorithm for image detection and tracking. The core technology of face recognition is the recognition algorithm. In addition, the recognition accuracy and efficiency are the general indicators to measure the algorithm. Face recognition technology is an interdisciplinary subject. It is a process of continuous integration of mathematical statistics, biotechnology and other disciplines. From the beginning of simple mathematical statistics and model processing, to the following neural network based on machine learning, and then to in-depth learning, every progress of face recognition technology has distinct stages. Characteristic. Face recognition does not require any operation of the acquisition object. It only needs to stay in front of the acquisition equipment for a moment. It can also be hidden acquisition. Compared with the passive acquisition methods such as fingerprint and iris, it is more difficult to detect, relatively more secure and reliable, and it is not easy to be forged. Face recognition needs two parts: face detection and face recognition. According to statistics, the accuracy of face recognition algorithm has reached 99.15%. Therefore, face recognition technology is recognized as one of the important technologies of information security authentication. Face detection is an effective data input, through the corresponding algorithm to determine whether there is a face, after detecting the face, according to certain biological laws and other methods to obtain evidence of the face, the obtained face features and computer reserved face features are compared, and finally the results of face recognition are obtained. The core is about the extraction of facial features from captured images, but preprocessing is also an essential step, which provides services for the process of feature extraction. The process of face recognition is shown in Figure 1.

![Figure 1. Process diagram of face recognition](image)

2. Application strengths and weaknesses of face recognition technology in smart campus

2.1 Application strengths
In the acquisition process of face recognition technology, users do not need direct contact with equipment, using face active capture technology to identify user information. Compared with other human biometrics recognition systems such as fingerprints and genes, face recognition is more friendly, convenient, natural and easy to be accepted by ordinary people. The results are intuitive, and can solve problems without disturbing normal life. At the same time, more useful information can be obtained by analyzing expressions and gestures. In practical application scenarios, multiple faces can be sorted, judged and recognized. Face brushing recognition, payment and so on, users can complete identity authentication directly through face recognition without manual recognition, and the efficiency and accuracy are relatively reliable. The basic principle of face recognition technology is to collect images or video streams containing faces by cameras or cameras, and extract the feature data of face images to search and match the feature templates stored in the database. By setting a threshold, when the similarity
exceeds this threshold, the matched results are output. Using the method of neural network in-depth learning, the face recognition rate of the system is very close to that of human eyes, even more than that of human eyes. The application of face recognition technology in university informatization is not only a technological innovation and breakthrough, but also a breakthrough and innovation in the construction of educational informatization. The university has realized student’s self-registration, self-management of train ticket discount card recharge, self-printing of transcripts, self-management of in-service certificates and other business. Face recognition has become an indispensable bright spot in the construction of smart campus.

2.2 Application weaknesses
Although face recognition has unique advantages and broad application prospects for smart campus applications, there are still some errors in face recognition due to the influence of external factors such as illumination, occlusion, facial expression changes. Therefore, authorization confirmation should be added in authorization and consumer applications of face recognition technology. Face recognition technology relies on the Internet, big data and cloud computing. It needs the support of network, massive data and storage space. It has higher requirements for the infrastructure construction of smart campus, resulting in the increase of technology, equipment and human cost. Face database leakage will cause immeasurable loss to users. It is necessary to use technical means to add watermarking to the data of feature image database, encrypt and process the collected image data, strengthen the construction of Internet security, formulate and implement the corresponding risk control system and norms, and cope with the leakage incident. With the open source and widespread application of face recognition technology, some illegal elements have developed pseudo-face technology for face recognition technology, such as three-dimensional image technology. By special processing of a face photo, three-dimensional shaking and nodding can be achieved. In addition to avoiding such risks by means of cross-validation, we need to further overcome the technical difficulties in biopsy testing. It also needs a lot of video acquisition equipment, high-definition cameras with high price to form a certain scale.

3. Main applications of face recognition technology in smart campus

3.1 Build safe educational environment
In the past, the management of import and export relied on the gate guard registration. New employees, visitors and new students came in and out for inspection and registration of forgetting documents. The heavy work, strong data lag and traceability difficulties brought various troubles to the school educational work. At the same time, a slight negligence of school security may lead to campus security problems. Every year, colleges organize various subject examinations, social examinations, competitions and so on. Additional manpower and material resources are needed to identify the participants, especially at the national level. The requirements for examinee identification are more stringent. Usually, the invigilator compares the examinee’s card and admission photo manually, but because the invigilator's identification ability has not been specially trained, the identification ability is lower than that of the public security organ professionals, and the identification efficiency is low, there is still the possibility of substituting for the examinee. If face recognition technology is used, it can be compared with the data of the examinee entered in advance. Effective improvement of the above problems.

With the gradual expansion of the scale of the school, the crime on campus is also increasing year by year. However, due to the sudden and uncertain nature of the crime, the complexity and difficulty of school supervision are also strengthened. At present, a large amount of video data is produced and stored in the database of the campus monitoring system every day, but the work of face recognition still remains in manual investigation and human identification. In the phase of work comparison, if face recognition technology is used, people in the existing video surveillance data on campus can be identified and early warned automatically. Quantum face recognition terminals are deployed in important places such as dormitories, laboratories and clinics. According to the uniqueness of facial biology information,
effective information such as safety of personnel access management, real-time control of personnel access and residence time is guaranteed. The ability of early warning and timely traceability after the event is improved, and campus security is strengthened.

In addition, facial recognition devices such as campus and dormitories, libraries, canteens can also achieve accurate work attendance, regional access control, spot patrol, improve the accuracy of attendance, and also prevent cheating. The automatic generation of attendance reports provides convenience for attendance management.

3.2 Create convenient business processes
By combining the smart terminal of face recognition with the teaching, campus resources and existing application systems of the school, in order to improve the security level of the campus and convenient information service, we put forward a complete smart education scheme based on face recognition, which covers the campus, teaching buildings, dormitories, libraries, entrances and exits, and children. The front-end control of children's gardens, primary schools, training institutions and other corresponding positions, as well as the control of duty rooms, computer rooms and management centres.

When freshmen and new employees check in, the system collects multi-angle and multi-expression photos of teachers and students through cameras, and records basic identity information, supplements the campus basic database, and provides strong data support for other business platforms. Face recognition system can quickly identify the user's identity. Therefore, when teachers and students use the unified portal of smart campus to login, they can login to view and browse the portal only by using the acquisition platform of face recognition system.

We use face recognition landing terminal or wall-mounted terminal in front of the classroom to improve attendance efficiency and avoid loopholes in traditional attendance mode. Face recognition terminal is used to verify the identity of candidates and candidates, to prevent the phenomenon of substitution for the examination, and the lost examination certificates can also enter the examination room. Face wall-mounted entrance guards are installed in archives, conference rooms and laboratories. Face recognition and matching can only be accessed to avoid unauthorized carrying of high-risk items, information leakage, property loss and so on.

In dealing with all kinds of applications, or all kinds of business that must be verified by myself, the second facial brushing authorization and related business are adopted. For other business systems that are not included in the unified portal, the identity authentication can also be carried out through the database of the face recognition system to realize the non-card login. Face recognition system can be used to collect, identify and record user information quickly in all books, classrooms and venues on campus. By matching authorization information, corresponding user rights and use records can be obtained.

3.3 Develop personalized technology service
Smart campus is to achieve the integration of various services, through the authorization of different roles, personalized information services, through active recording of all information in the smart environment, and make full use of large data technology, mass data storage, analysis, reasoning, judgment, prediction. Face recognition technology support active recording, combined with smart campus integration services, can achieve one-stop service, behaviour analysis, decision support services and other more humanized and personalized services. According to collecting and analysing the records of teachers and students in campus, dormitory buildings, dormitories, classrooms, training rooms, libraries, gymnasiums and various business platforms, we can form a large database for specific users, from which we can analyse the frequency of use of various places, user’s learning habits, activities habits and so on. According to the frequency of use at different times, early warning is provided for users; according to the law of students’ trajectory, analysis and early warning of learning behaviour are provided to teachers; according to the utilization rate of classrooms and training rooms, borrowing rate, adjustment and early warning of training rooms are provided to the educational administration department and professional teachers. One-stop service is a new smart campus management platform in
colleges and universities. Teachers and students can directly log on to the campus management platform for related business with the help of mobile terminal equipment. However, the default maintenance of authorized login function of mobile phone software leads to the risk that other people use terminal devices to do some personal business. Therefore, in dealing with key business, we add real-time video and photography functions. Through face recognition technology, we can ensure the correct authorization of one-stop service.

4. Design, implementation and testing of campus dormitory management system based on face recognition

4.1 System design
The system development adopts B/S architecture, which can be logically divided into presentation layer, business logic layer and data access layer, supplemented by the standard specification of system design and information security configuration, constituting the design framework of this student dormitory management system, as shown in Figure 2. Based on the system structure, business logic, data and interface can be separated, development efficiency can be improved, and it is conducive to the subsequent expansion and maintenance of the system.

Figure 2. Design framework of campus dormitory management system

The basic function module of the system mainly includes the daily storage, maintenance and user rights management of the platform. The system maintainer can monitor the system and the operation of the identification terminals in real time through the module, maintain and manage the system data and manually backup the system data, modify the operation rights and processing department of the existing users of the system. Audit the important information. A special information query module is set up in the system platform to provide corresponding query functions for different types of system users. The administrator with higher authority can see all the query modules, and the query data can be counted and exported in the form of reports. Other types of users see only some of the modules. Under the query module, the student information function provides the corresponding query interface for different users. Students will encounter various situations in their daily dormitory life. This sub-module is designed to manage the daily needs of students. It has facilities maintenance, daily payment, application for changes in dormitories and daily registration. Student users can use this module to pay fees and submit
maintenance and other types of applications. After approval by the administrator, the feedback is recorded in the database. The system designs the function sub-module separately for visitors. Visitors inquire the students under the inquiry module and fill in the brief information here. After approval by the administrator, they set the visit time limit and give feedback.

4.2 System implementation

After the user logs in the system, he enters the main interface of the dormitory management system. According to the previous design of the system module, this page is divided into system management, information query, business management and visitor management module specially designed for visitors. The user type is judged according to the flag value judged at the time of login. If the valid user clicks, the prompt box pops up and refuses to visit. Query module displays different contents for different types of users, and uses flag parameters to determine the type of users to display corresponding pages and functions. Visitor users only display student information query function, and can only query student information accurately by name or student number, and display only part of the data when inquiring details to protect the system data; student user rights are similar to visitor users, but you can see my detailed information, and click on attendance information, daily business. In the sub-module of daily business management function, the application submitted by students can be viewed and managed, and the batch processing can be approved or rejected. The search function is set up in the sub-module, which can search the application information accurately according to the name and student number, and also according to the time range. After the system is deployed on the server, the platform can be accessed without the need to develop APP to access the hostel system to save the development cost. The mobile dormitory management platform has some functions of simplified system platform.

4.3 System testing

For the performance testing of platform system, we use the method of case testing to detect the response time of the system. The results are only for reference. The test examples and results are shown in the table below. The test includes common page jumps, queries, information data uploads, statistics and reports. The results show that the response time is within the expected range, which are shown in Table 1 and Table 2.

| Total test number | 1200 |
|-------------------|------|
| Accurate number at the first time | 1124 |
| Accurate rate at the first time | 93.7% |
| Cumulative accurate number at the first and second time | 1192 |
| Cumulative accurate rate at the first and second time | 99.3% |

| Testing Item     | Result | Time (second) |
|------------------|--------|---------------|
| User login       | Success| 0.224         |
| Precise query    | Success| 0.551         |
| Fuzzy query      | Success| 0.982         |
| Data upload      | Success| 0.311         |
| Picture upload   | Success| 3.014         |
| Report generation| Success| 2.681         |
| Query statistics | Success| 2.364         |

The results show that the system in operation basically meet the expected goals. The deficiency of system function and program bug are unavoidable. Through the actual operation test and continuous optimization in the later period, we can gradually improve the performance of campus dormitory management system and improve its stability.
5. Conclusions

Although face recognition technology still has some insurmountable shortcomings, it has the advantages of convenience, high efficiency, low cost and high accuracy. These advantages make people's demand for its use increasing day by day. Face recognition technology has gradually entered the family, campus and society, facilitating people's lives. At present, the deep combination of AI and education has gradually entered the deep-water-area. Scholars should focus on in-depth learning and the development of embedded computer vision technology, so that face recognition technology can enter the education industry with a lower threshold. We should let science and technology really solve the pain points of education to construct smart campus fast and well.

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