Development and Research of Intelligent Defense System Based on Python

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Abstract: *With the rapid development of information technology, the forms of course defense, mid-term and final defense and graduation project defense in the process of college teaching need to keep pace with the times. This paper introduces the development and research of an intelligent defense system based on Python, which aims to solve the limitations of traditional defense methods, such as time and place constraints and insufficient time for problem thinking. The system includes front-end pages, main programs, back-end databases, websites deployed on the public network and other parts. After actual testing and theoretical stress testing, the system can complete the expected defense function, providing convenience for university teaching.*

Keywords: *Python; Defense system; Database; Online education*

1. Development background and significance

In the field of higher education, defense, as an important assessment method, is widely used in various courses, mid-term and final examinations, and graduation design. However, the traditional defense method usually adopts the face-to-face form of teachers and students, which is intuitive and interactive, but limited by objective conditions such as time, place and time for thinking, resulting in the defense process is often not flexible enough, inefficient, and prone to omissions[1].

With the rapid development of information technology, especially the extensive application of online education technology, it is possible to innovate the way of reply. The intelligent defense system based on Python is the product of this background. The system uses the powerful function and flexibility of Python language, combined with MySQL database and other back-end technologies, to build a platform that can conduct online defense. Through this platform, teachers can create defense topics and set defense time anytime and anywhere, and students can defend online. The system can also automatically record the defense process and generate defense reports, greatly improving the efficiency and accuracy of defense[2-3].

2. Principle of operation

In the process of developing the intelligent defense system based on Python, we have adopted a series of technologies and modules to realize various functions of the system. These functions include user interface design, account management, audio and video recording and synthesis, as well as video file storage and sharing. The working principle of the system will be described in detail below, including the basic logical framework, interface design, account management, audio and video processing, video file upload and sharing, etc.

The basic logical framework of the Smart Response System is the core of the system's operation. It defines how the system handles user requests, manages data and performs various functions. In this framework, we adopt the modularization design idea to divide the system into different modules, each of which is responsible for handling specific tasks. These modules include user interface module, account management module, audio and video processing module, and file storage and sharing module[4].

The user interface module is responsible for interacting with users, receiving user input and displaying system output. We used Python's Tkinter library to write the general framework and buttons of the user interface. Tkinter is a powerful graphical user interface (GUI) library, which allows us to create various complex user interfaces, such as windows, buttons, text boxes, etc. Through Tkinter, we

can design an intuitive and easy-to-use defense system interface, so that users can easily complete the defense process[5].

The account management module is responsible for processing the user's account information, including account creation, login, password modification, etc. To ensure the security of user information, we use MySQL database to store user account data, and use hash encryption technology to encrypt and save passwords. Hash encryption is a one-way encryption method, which converts the password into a fixed length string (hash value), making it impossible to restore the original password even if the hash value is known. This can effectively prevent the password from being disclosed or cracked[6].

Audio and video processing module is one of the core parts of the system, which is responsible for the realization of audio and video recording and synthesis functions. We use OpenCV (cv2) and other modules to process audio and video data. OpenCV is an open source computer vision library, which provides a large number of functions and tools to process image and video data. Through OpenCV, we can capture, encode, decode and synthesize audio and video data. In the defense system, we use OpenCV to record students' audio and video data and synthesize them into a complete defense video file.

The file storage and sharing module is responsible for uploading the synthesized video file to the server, and uploading the corresponding website of the video to the MySQL database for teachers to view online. We have selected an appropriate ECS as the storage platform for video files, and used FTP or HTTP and other protocols to upload and download files. At the same time, we also designed a database table to store the metadata information of video files, such as file name, upload time, viewing links, etc. Teachers can log in to the system and access the database to view the defense video of students, and score and feedback them[7-8].

3. Software architecture

When building an intelligent defense system based on Python, the design of software structure is crucial. This system uses Python as the main programming language, combines tkiner, cv2, pandas and other modules to achieve core functions, and uses HTML to write back-end web pages, and MySQL as the database management system. Finally, the software body is packaged as an. exe file, which is convenient for users to use directly without installing the Python environment. The structural design of the software will be described in detail below.

3.1 Design of the main body of the software

3.1.1 Main interface design

The main interface is the starting point of user interaction with the system, which carries the main functions and interface elements of the system. The design of the main interface should be simple, clear and easy to operate. In this system, the main interface provides the function of changing the school logo, which allows users to customize the interface according to their own needs and enhance the personalization of the system. In addition, the main interface also contains a button with the function of entering the system, which, when the user clicks on it, will enter the login interface of the system[9].

3.1.2 Design of the login screen

The login interface is an important interface to verify the user's identity. In this system, the login interface contains two input boxes, which are used to input the account number and password respectively. At the same time, the interface also contains three buttons: Register, Login and Logout. By clicking the Register button, the user can enter the account registration interface for account registration; by clicking the Login button, the system will verify whether the account number and password entered by the user are correct or not, and jump to the corresponding main interface according to the type of account (teacher or student); by clicking the Exit button, the user will exit the login status and return to the main interface.

During the login process, the system verifies the user's identity by comparing the account number and password entered by the user with the information stored in the database. For the distinction between teacher account and student account, the system can be realized by setting different account type identifiers in the database. When the system recognizes the teacher's account, it will automatically jump to the main interface of the teacher; otherwise, it will jump to the main interface of the student[10].

3.1.3 Design of the account registration interface

The account registration screen is used to create an account for a new user. In this system, the account

registration interface contains two input boxes and two buttons. The input boxes are used to input the account number and password respectively; the buttons are registration and exit buttons respectively. The user enters his/her account number and password in the input box, and then clicks the Register button to complete the account creation. At the same time, the system will verify the account number and password entered by the user to ensure the uniqueness of the account number and the complexity of the password. If the verification passes, the account is successfully registered; otherwise, the user will be prompted to re-enter.

3.1.4 Design of the main student interface

The main interface of the student is the main interface for students to operate the defense. This interface contains functions such as drawing questions, answering questions in the specified time, recording video and background audio/video synthesizing. After entering the main interface, students first need to draw questions. The system will randomly select a question from the question bank for students to answer. After the students finish answering the questions within the specified time, the video recording will be carried out. During the recording process, the system will capture the student's audio and video data in real time and synthesize them. After recording, the system will automatically generate a defense video file and save it to a designated location for subsequent viewing and sharing.

3.1.5 Design of the main teacher interface

Teacher's main interface is the main interface for teachers to manage the question bank and student information. This interface contains five buttons: Update Question Bank, Empty Question Bank, Import Student Information, Empty Student Information and Exit System. Clicking Update Question Bank button, the teacher can add new questions to the question bank; clicking Empty Question Bank button, the system will empty all the questions in the current question bank; clicking Import Student Information button, the teacher can import the information of the students of this class to the system; clicking Empty Student Information button, the system will empty all the information of the students that have been imported; clicking Exit System button, the teacher will exit the teacher main interface and return to the main interface.

In order to facilitate management, the system requires teachers to use the format of "js+faculty number" when registering accounts. In this way, the system can identify the identity of teachers and assign them corresponding permissions by resolving account information. At the same time, student accounts are registered with "student number" to facilitate association and matching with student information.

3.1.6 Schematic Flowchart

The schematic flowchart of the system is shown in Figure 1. The flowchart shows in detail the whole process from user login to exit the system as well as the jump relationship between various sectors. Through this flowchart, users can clearly understand the operation principle of the system and the use of the process.
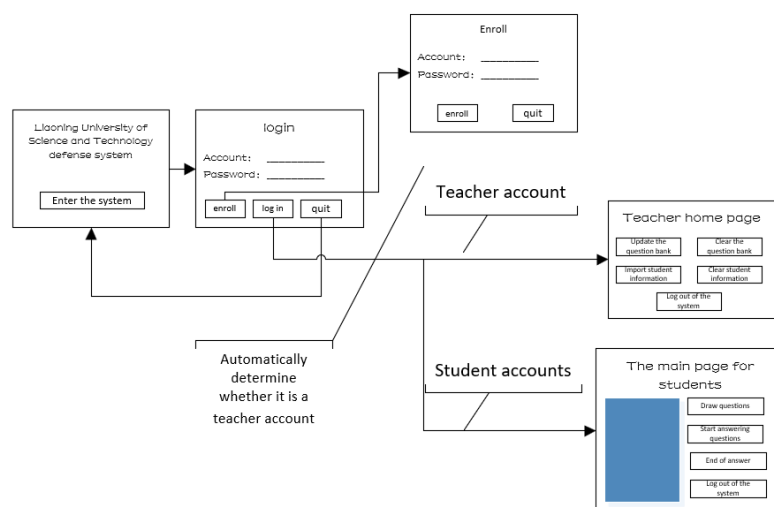

Figure 1: The schematic flowchart of the system

3.2 Software back-end processing design

In the construction of intelligent defense system, the design of background processing is a crucial part. The background processing not only involves data storage, processing, transmission, but also involves the configuration, deployment and maintenance of the server. This section will elaborate on the two design options of software background processing: centralized processing solution and sub-functional processing solution, and analyze the advantages and disadvantages of the two options.

3.2.1 Centralized treatment programmes

The centralized processing scheme is a relatively simple and commonly used background processing scheme. It uses the Windows Server system as the server platform and deploys NGINX, MySQL and necessary modules in it. The feature of this scheme is that all functions are processed on one server, which is convenient for management and maintenance.

3.2.1.1 Server configuration

On the Windows Server system, you need to install and configure NGINX as the Web server first. NGINX is a high-performance HTTP and reverse proxy server, which can process the data transmitted from the front end, and support reading student defense videos and other functions. By configuring the server block, location block and other parameters of NGINX, access control to static resources, dynamic pages and API interfaces can be achieved.

Next, you need to install and configure the MySQL database. MySQL is a popular open source relational database management system, which can be used to store user information, topic data, defense video links and other background data. By creating objects such as databases, table structures, and indexes, you can store, query, and update data.

In addition, necessary Python modules and dependency libraries need to be installed and configured to support logic processing and data processing functions in the background. For example, Pandas can be installed for data processing and analysis, and cv2 can be installed for audio and video processing.

3.2.1.2 Firewall Configuration

After configuring the server, you need to set the firewall in the server to ensure that the system can run normally and accept the data transmitted by the front end. The ports used by NGINX and MySQL services need to be allowed to pass through the firewall so that the front end can access these services. At the same time, the inbound and outbound rules of the firewall need to be configured to prevent malicious attacks and data leakage.

3.2.1.3 Analysis of strengths and weaknesses

The centralized processing scheme has the advantages of simple deployment and convenient management. Since all functions are processed on one server, it is convenient to monitor and debug the running status of the system. At the same time, the Windows Server system has an operating interface and rich management tools, so that novices can easily get started.

However, the centralized processing scheme also has some shortcomings. First of all, the Windows system has a high resource utilization rate, which cannot give full play to the full performance of the hardware. This may lead to system performance degradation or crash in high concurrency scenarios. Secondly, the security of Windows system is relatively low, and it is vulnerable to malicious attacks and virus intrusion. In addition, because all functions are processed on one server, the entire system will be affected if the server fails or crashes.

3.2.2 Sub-functional processing programs

The sub function processing scheme is a more complex but flexible background processing scheme. It adopts Proxmox Virtual Environment (PVE) or Esxi underlying virtual system, and deploys multiple virtual systems on it to handle different functions.

3.2.2.1 Virtual system deployment

On the PVE or Esxi underlying virtual system, you can create multiple virtual machines to deploy MySQL, NGINX and other services respectively. Each virtual machine has an independent operating system and resource configuration, which can be customized and optimized as needed. By deploying databases and websites on different virtual machines, you can achieve functional separation and independent maintenance.

During deployment, it is necessary to ensure that the firewalls of the underlying system and of each virtual machine where the relevant functionality is deployed are released. This can be accomplished by configuring the inbound and outbound rules of the firewall to ensure that data can be transferred securely between different virtual machines.

3.2.2.2 Analysis of advantages and disadvantages

The advantages of the functional processing scheme lie in flexibility and scalability. By deploying different functions on different virtual machines, independent maintenance and expansion of functions can be achieved. At the same time, using PVE or Esxi underlying virtual system can give full play to the performance of hardware and improve the overall performance of the system. In addition, since the database and website are deployed on different virtual machines, even if one of the virtual machines fails or crashes, the normal operation of other virtual machines will not be affected.

However, the sub functional processing scheme also has some shortcomings. First, it is difficult to deploy and maintain. As it involves the configuration and management of multiple virtual machines, a certain degree of virtualization technology and Linux system knowledge is required. For beginners, it may take more time and energy to learn and master relevant knowledge. Secondly, due to the use of a very useful operating system (such as PVE or Esxi), there may be some compatibility and stability problems. In addition, data transmission between virtual machines may be limited by network bandwidth and latency.

3.2.3 Recommendations for program selection

When choosing a back-end processing solution, there are trade-offs and choices to be made based on the actual situation. For beginners or small projects, a centralized solution may be more suitable. It is simple to deploy, easy to manage, and has an interface and rich management tools. However, for large-scale projects or application scenarios that require high performance and reliability, a split-function processing solution may be more appropriate. It can fully utilize the performance of the hardware, improve the overall performance of the system, and have better flexibility and scalability. At the same time, in order to ensure the security and stability of the system, but also need to pay attention to the configuration of the firewall and network security management.

4. System applications and outlook

With the rapid development of information technology, the field of education is also experiencing unprecedented changes. In this process, the intelligent defense system based on Python has become an indispensable part of the education field with its efficient, convenient and intelligent characteristics. This system not only optimizes the defense process and improves the efficiency of defense, but also provides a richer interactive experience for students and teachers. This paper will introduce the application of the system in detail, and look forward to the future development direction.

4.1 Status of system applications

4.1.1 Widely used in several universities

Since its development, the system has been successfully applied to the teaching and learning process at a number of universities. These universities cover a wide range of subject areas and levels, including undergraduate, master's and doctoral levels. In these universities, the system has been well received by both teachers and students, and has become a powerful aid in their defense activities.

4.1.2 Teachers' perceptions of use

For teachers, the system greatly reduces their workload. They no longer need to spend a lot of time and energy to organize and prepare for the defense activities, but only need to carry out simple operations in the system to complete. Through the system, teachers can organize the defense activities more flexibly without the limitation of time and place. They can check the students' defense at any time and monitor and manage the defense process in real time. In addition, the system can automatically generate defense reports and grade statistics and other functions, providing great convenience for teaching management.

4.1.3 Student perceptions of use

For students, the system provides them with a more convenient and efficient defense experience. They can prepare and submit their defense anytime and anywhere, and are no longer restricted by time

and place. During the defense process, students can view their defense situation in real time through the system, including the questions and comments of the judges. This not only helps students better understand their own defense performance, but also helps them find problems and make improvements in time. In addition, the system also provides a wealth of defense resources and support, such as question banks, video tutorials, etc., to provide students with more comprehensive learning support.

4.1.4 Increased efficiency in the management of teaching and learning

In addition to providing convenience for teachers and students, the system also has a positive impact on teaching management. Through the system, teaching managers can grasp the progress of defense activities in real time, and monitor and manage the defense process in real time. In addition, the system can automatically generate a variety of statistical reports and analysis reports to provide decision-making support for teaching managers. These functions not only improve the efficiency of teaching management, but also help to optimize the allocation of teaching resources and improve teaching quality.

4.2 System application case studies

In order to better illustrate the application effect of this system, the following will be analyzed with several specific cases.

Case 1: Oral defense of postgraduates of XX University

This system has been widely used in the postgraduate defense of XX University. Teachers can easily create and manage defense tasks through the system, and set defense time, place, judges and other information. Students register for defense and submit defense materials in the system. In the process of defense, students can view their defense in real time through the system and interact with the judges. After the defense, the system automatically generates defense report and score statistics, which provides great convenience for teachers and students.

Case 2: Oral defense of undergraduate course design of XX College

This system also played an important role in the undergraduate course design defense of XX College. Teachers use the system to create curriculum design defense tasks, and set corresponding defense requirements and scoring standards. Students submit course design works, defense PPT and other materials in the system. In the process of defense, the judges evaluate and score the students' works and defense performance through the system. Finally, the system automatically generates results such as score statistics and rankings according to the evaluation results of the judges, which provides comprehensive support for the curriculum design defense.

4.3 Future vision of the system

With the continuous development of information technology and the continuous reform in the field of education, the intelligent defense system based on Python will also usher in a broader development prospect. The following is the future development direction of the system:

4.3.1 Functionality Expansion and Optimization

In the future, we will continue to expand and optimize the functions of the system. Firstly, we can add more forms of defense, such as video defense, audio defense, etc., to meet the needs of different disciplines and levels. Secondly, the performance of the system can be further optimized to improve concurrent processing capability and stability. In addition, more intelligent functions can be added, such as automatic scoring, intelligent recommendation, etc., to provide more comprehensive and accurate support.

4.3.2 Cross-platform and integration

In order to meet the needs of more users and devices, cross-platform development and integration of the system can be considered in the future. By developing applications or plug-ins for different operating systems and devices, more users can use the system conveniently. At the same time, the system can also be integrated with other teaching management systems to achieve data sharing and interoperability. This will help optimize the allocation of teaching resources and improve the quality of teaching.

4.3.3 Intelligence and Personalization

With the continuous development of artificial intelligence technology, more intelligent technology can be applied to this system in the future. For example, machine learning algorithms can be used to

analyze and mine the defense data to find potential teaching problems and improvement directions. At the same time, it can also be customized according to the user's individual needs to provide services and support that better meet the user's needs. This will help improve user experience and satisfaction.

4.3.4 Internationalization and globalization

With the accelerating trend of globalization, the system can be considered for international development and promotion in the future. By developing multi-language versions and adapting to the requirements of laws, regulations and cultural habits of different countries and regions, the system can be made available to users in more countries and regions. This will help expand the scope of application of the system and improve international competitiveness.

To sum up, the intelligent defense system based on Python has been widely used and recognized in the field of education, and will play an increasingly important role in the future development. We will continue to be committed to the optimization and expansion of the system to provide users with more efficient, convenient and intelligent services and support.

5. Conclusion

Python, as one of the most popular programming languages today, is open source and free, powerful, easy to learn, and has clear logic, which makes it show excellent performance and wide application in many fields. Especially in the field of education, Python's flexibility and scalability provide strong support for the development of various educational software. The intelligent defense system based on Python discussed in this paper is a vivid embodiment of this feature.

5.1 Advantages of Python

The advantages of Python language are mainly reflected in the following aspects:

1) Open source and free: Python's open source feature makes it the preferred programming language for many developers. This means that developers can obtain Python source code for free, and modify and extend it according to their own needs. This flexibility greatly reduces development costs and promotes the rapid development of the Python community.

2) Powerful functions: Python has rich built-in libraries and third-party libraries, which provide strong support for computer hardware, software, network and other resources. For example, Python can easily control the computer's camera and microphone, and can also automate the operation of software such as Excel. This comprehensive functional support enables Python to cope with various complex development requirements.

3) Easy to learn: Python has simple and clear syntax and clear logic, enabling beginners to quickly start. At the same time, the Python community provides a large number of learning resources and tutorials to help developers constantly improve their skills.

4) Mature module development: Python's module development is very mature, covering various fields from data processing, network programming to artificial intelligence. These mature modules provide powerful support for developers, enabling them to focus more on the implementation of business logic rather than getting bogged down in tedious technical details.

5.2 Application and significance of intelligent defense system

The intelligent defense system based on Python has brought great convenience to college course defense and graduation defense. First of all, the system breaks the shackles of traditional defense limited by time and place, making defense activities more flexible. Students and teachers can prepare and review the defense according to their own schedule, which greatly improves the efficiency and convenience of defense.

Secondly, the intelligent defense system can accurately control the time of the defense to ensure that each student has enough time to present his/her research results and defense performance. This precise time control helps the judges to assess the students' defense level more accurately, which improves the fairness and referability of the defense results.

In addition, the intelligent defense system also has the functions of automatic generation of defense report and grade statistics, which provides great convenience for teaching management. These functions

not only reduce the workload of teaching managers, but also help optimize the allocation of teaching resources and improve the quality of teaching.

With the continuous development and application of artificial intelligence technology, the intelligent defense system based on Python will have a broader application prospect. We can expect more intelligent functions to be added to the system, such as automatic scoring, intelligent recommendation, etc., to provide more comprehensive and accurate support. At the same time, with the continuous improvement and optimization of the system, its application in the field of education will be more and more extensive, making greater contributions to the progress and development of education.

Acknowledgements

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