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Educational research on mathematics differential equation to simulate the model of children's mental health prevention and control system

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Abstract

In order to solve the practicality of the infant mental health tracking system, the system is simulated based on mathematical differential equations. The SSH framework technology of the mode-view-controller (MVC) design model analyses and designs the model of the prevention and control system of children's mental health. In this design pattern, the Struts framework is used to realise the separation of the view layer, the business layer and the control layer, and the Hibernate framework is used to realise the data persistence layer, thereby obtaining a system solution with strong scalability, low coupling and easy maintenance.

Keywords: prevention and control system model, mathematical differential equations, tracking system, children's mental health, hibernate framework

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1 Introduction

Due to the physical and psychological peculiarities of young children, various psychological contradictions and conflicts are prone to appear; coupled with the complexity of today's society, various contradictions are intricate, which exacerbates the seriousness of young children's psychological problems. Therefore, by constructing a psychological consultation room to solve the psychological problems encountered by children in the process of work, study and life in school. However, due to a large number of young children, it is difficult for mental health counselling teachers to conduct detailed consultation and follow-up on each child one by one, and work

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omissions often occur. In order to solve the above problems, in view of the actual problems in contemporary children's mental health, combined with the application trend of information technology in mental health education, this paper proposes an SSH framework for children's mental health information tracking system based on the mode-view-controller (MVC) design model.

2 Technology and method

2.1 MVC mode

MVC is a framework mode that compulsorily separates the input, processing and output of the application. Using MVC applications is divided into three core components: model, view and controller, each of which handles its own tasks.

M refers to the data model. It is the core of the MVC design pattern. It encapsulates the core process and business rules of the system. It is the internal abstraction of the problem logic handled by the software independent of the external display content and form. It is independent of the concrete Express and I/O operations. V refers to the user interface, which is the interface that the user sees and interacts with. It is mainly responsible for displaying relevant data to the user and can accept the user's input data, but it does not perform any actual business processing. It obtains the display information from the model, and there can be multiple different display forms or views for the same information. C is the controller. The controller defines the behaviour of the application, interprets user actions, is responsible for the synchronisation between the model and the view, accepts user input and calls the model and view to complete the user's request. Usually, a view has a controller. The purpose of using MVC is to separate the implementation codes of M and V so that the same program can use different manifestations. The purpose of C is to ensure the synchronisation of M and V. Once M changes, V should be updated synchronously. Figure 1 shows the respective functions of the three modules and the relationship between them [1].

Fig. 1 MVC mode. MVC, mode-view-controller.

For the development of Web applications, it is not easy to design and develop a reliable and stable framework from scratch. With the maturity of Web development technology, there are some ready-made excellent frameworks in the field of Web development, and developers can use them directly. The front-end development of this system uses the Struts framework, the data mapping uses the Hibernate framework and the Spring framework is used to ensure the integrity of the data.

2.2 Overview of Struts technology

The Struts framework is a typical framework based on the MVC mode application architecture. Struts provides implementation components for these three classes. The implementation components used by the system for these three classes are Java-a Bean, Java Server Pages (JSP), Servlet and the Struts framework structure is as follows as shown in Figure 2. The Struts technology is mainly used on the M (presentation layer) of the MVC mode. The processing flow of the Struts framework clearly reflects the advantages of the MVC mode. The biggest feature of using Struts technology to design the presentation layer is to put a lot of logic in the configuration file instead of the program, so as to avoid the need to change the program when business needs change in the future.

Fig. 2 Struts frame structure. JSP, Java Server Pages.

2.3 Overview of hibernate technology

Hibernate is a full-featured, open-source OR mapping framework on the Java platform. It is an object/relational database (Object/Relational Mapping [ORM]) mapping tool oriented to the Java environment. It not only manages the mapping of Java classes to database tables (including the mapping of Java data types to SQL data types) but also provides data query and retrieval the data method can greatly reduce the time of manually using SQL and JDBC to process data during development. Compared with using JDBC and SQL to manually operate the database, using Hibernate can greatly reduce the workload of operating the database [2].

Fig. 3 Hibernate frame structure.

As shown in Figure 3, it is the Hibernate framework structure. The application program has a relationship with the database through Hibernate and operates on the data. Hibernate itself maps classes to rows in the database through properties and the class mapping file (mapping.xml). Thus, applications can directly access the database through persistent object classes, instead of having to use JDBC and SQL for data operations.

2.4 Overview of spin technology

The Spring framework provides a full-featured MVC module for building Web applications. Using Spring's pluggable MVC architecture, you can choose to use the built-in Spring Web framework or a Web framework such as Struts. Through the strategy interface, the Spring framework is highly configurable and contains a variety of view technologies, such as JSP technology, Velocity, Tiles, item and POI. Spring separates the roles of the controller, model object, dispatcher, and handler object. This separation makes them easier to customise. The Spring frame structure is shown in Figure 4.

Fig. 4 Spring frame structure.

2.5 SSH architecture

SSH is an integrated framework of Struts+Spring+Hibernate and is currently a popular open-source framework for Web applications. Among them, using Struts as the overall system infrastructure, responsible for the

Fig. 5 SSH three-tier architecture system.

separation of MVC, in the model part of the Struts framework, the Hibernate framework is used to provide support for the persistence layer, and the business layer is supported by Spring. Each layer has clear functional responsibilities and should not be mixed with other layers. Each layer is connected with the other through communication interfaces. The three-tier SSH architecture system is shown in Figure 5.

2.6 Design of data collector

The data collector in the system hardware is composed of chips CP2210 and C8147 single-chip micro-computer, which realises network big data collection and transmits the collected data to the network processor through the network interface. The hardware structure diagram of the data collector is shown in Figure 6.

Fig. 6 Data collector structure diagrams.

It can be seen from Figure 6 that the data collector power supply sends out a 6 V voltage, which is transmitted to the microcontroller voltage regulator through the REGIN pin of the microcontroller, adjusts the voltage to the 4 V voltage required for the microcontroller to work and passes the remaining 2 V voltage through the VDD pin to send it to other parts for use. The one-chip computer exchanges information through P3, P4 and other I/O pins. The signal obtained from the network passes through the signal adjuster and reaches the A/D converter from the P25 pin of the single-chip microcomputer. The A/D converter converts the signal into corresponding data, thereby completing the network data collection.

2.7 Storage module design

The storage module is the core of the big data classification system and is used to store all the data in the system. Before constructing the storage module, it is necessary to clarify the system requirements, and then map tasks to different types of analysis models and mining models through the semantic layer, and use the data in the system to obtain the final solution. Based on the hierarchical model method and the group collaborative intelligent clustering hierarchical model, this paper divides the storage modules of the big data classification system into the application layer, functional layer, semantic layer, design layer and data layer. The specific structure is shown in Figure 7.

In Figure 7, the application layer is the top layer of the storage module of the big data classification system, which can describe, distinguish and assign tasks; the function layer is the support structure of the application layer, including related function codes, and the function layer is the big data in the data. The storage module is a bridge for interaction with users; the semantic layer realises the transformation from the data model of the design layer to the business of the functional layer and converts the data model of the design layer into business terms for description; the design layer uses the information package diagram to set classification based on system requirements. Content visually describes the classification of data through the data model and respond to the retrieval needs of users of the big data classification system in real time; the data layer organises the big data through system control events, accesses the source data of the system to complete the extraction and integration

Fig. 7 Storage module structure diagrams.

of the source data and other operations, and its storage is designed as a relational database structure for the query [3].

2.8 Differential classification mathematical model

In order to achieve big data classification, the system software uses differential equations for data classification processing and establishes a second-order delay differential equation in the Bochner-Riesz space:

$$\dot{x}(u) = Bx(u) + Cx(u - e(u)) \quad (1)$$

In Eq. 1, $e(u)$ is the time delay term in the stable state $x(u)$ of the characteristic solution of the second-order delay differential equation; B and C are the parameters of the second-order delay differential equation. The eigenvector of the second-order delay differential equation at the boundary stable equilibrium point $eQ_i(u)/(eu) = U_i(u)Q_{UQ_i} + L_i(u)Q_{LQ_i}$ is expressed as:

$$\varphi_1(e_1(u)) = \varphi + e_1(u)Q(X_1 + X_2 + X_3)^{-1}Q^U + (u_1 - e_1(u)) \left[QX_1^{-1}Q^U + L(X_2 + X_3)^{-1}L^U \right] \quad (2)$$

In Eq. 2, $L_i(u)$ and $U_i(u)$ are used to describe the stable state of the parameter u at the lowest point and the highest point of the boundary, respectively; Q_{LQ_i} and Q_{UQ_i} represent the lowest and highest equilibrium points of the boundary, respectively; $E\varphi$ represents the eigenvector of the characteristic solution of the second-order delay differential equation [4].

Perform Lyapunov functional processing on the stable solution of the second-order delay differential equation at point F. According to the optimisation theory, a new geometric region is obtained. By constructing an appropriate Lyapunov functional and adding the auxiliary integral matrix, the second-order delay differential is

obtained the stable solution of the equation is:

$$v_1 = \begin{bmatrix} v_{11} & Uv_{13} & Q_1 & 0 & 0 & 0 \\ 0 & v_{22} & Uv_{24} & Q_2 & 0 & 0 \\ 0 & 0 & v_{33} & Uv_{35} & Q_3 & 0 \\ 0 & 0 & 0 & v_{44} & Uv_{46} & Q_4 \end{bmatrix} \quad (3)$$

$$v_1 = \begin{bmatrix} Q_5 & 0 & 0 & 0 & v_{55} & Uv_{57} \\ Uv_{68} & Q_6 & 0 & 0 & 0 & v_{66} \end{bmatrix} \quad (4)$$

Under the stability constraint of the double limit condition, taking the solution vector of the region $M(0)$ adjacent to the origin as the initial condition, the parameters for the existence of stable solutions of the second-order delay differential equation are:

$$v_n = [V_{n+11} Q_{n+11} 000]^U \quad (5)$$

In the formula, it is the same as the average characteristic functional of v_1 . According to the periodic independent wave solution of the second-order delay differential term, the stable solution vector is used as the clustering centre vector of big data classification to construct the mathematical model of differential classification.

3 Results

3.1 System implementation

Based on the MVC model SSH framework, the child mental health information tracking system is based on the actual and specific conditions of our school's mental health education, comprehensively using modern information technology to reshape and recreate the child's mental health information, aiming to provide psychological counselling through Internet technology. The teachers can get timely and comprehensive information about children's various situations and trends. Compared with traditional infant mental health education, it truly reflects the superiority of modern IT technology in infant mental health education. At present, there is not much research on the application of mental health information to network tracking. In order to facilitate the future upgrade of the system, this system adopts the lightweight J2EE software framework of Struts2 + Sprint + Hibernate and the efficient and intelligent SQL Server 2008 database technology for development. The system has good scalability, reusability, portability and maintainability [5].

3.2 System design and implementation based on the MVC mode SSH framework

3.2.1 System requirement analysis

(1) System performance requirements. The overall principles of the design and development of this system are practical, efficient and stable, and easy to use and easy to operate, in line with the operating habits of regular Windows users. In addition, it is required to have a friendly interface, a high degree of visualisation, and complete, concise and effective prompt information. Specific performance requirements include (1) Reliability. During the use of the system, the capacity of the server is as large as possible to accommodate the number of customers accessing the system. This system can meet the requirements of 10,000 people logging in and their online consultation at the same time; and when users query the system, they should ensure that they are searched based on the accuracy rate and matching rate of query conditions. (2) Security. The system should have good security and should avoid information theft, system attack, etc., and should ensure the recovery of the system in case of disaster.

(2) System user requirements. This system is based on the Internet platform and provides different services for different types of users. The system users are mainly divided into teacher users, toddler users and system

administrator users. The teacher users can post psychological knowledge, view and reply to children's messages, etc.; the toddler users can view their own information, fill in psychological forms, view psychological knowledge and online consultation, etc.; administrator users import basic information of teachers and children, add administrators, export summary data of psychological barometer and retrieve passwords [6].

3.2.2 Module design of system function

The system mainly includes four functional modules: user management, knowledge base, information tracking service and system maintenance. (1) User management module includes four sub-modules: user login, user addition, user query and password modification. (2) Knowledge base module consists of three parts: knowledge base structure, knowledge base maintenance and knowledge search. (3) Information tracking service module: After the user logs in, the information tracking service module fills in the personal psychological barometer, i.e. tracking time, warning level, realising online psychological consultation, whispering psychology to the consultant and sending E-mail to the consultant. (4) System maintenance module mainly includes three aspects: database and webpage maintenance, and system security management.

3.2.3 System database design

The database is the core component of the system. If there is no database, the system is nothing. The most important step in the design of a database is the structure design of the back-end database. The most important design principle of the back-end database is that it must conform to the whole system needs. Combining the needs and functions of the system, guided by the standardised design of the database, after a detailed investigation of the archives of our school's psychological counselling centre, refer to the mental health system of other places, and finally check the teacher information table and the basic information of children involved in the system. Tables, question response tables, class information tables, psychological barometers and special data tables are designed [7].

3.2.4 Implementation and application of the system

The system requires the cooperation of multiple modules, and each module has an internal connection. The system uses Struts + Jsp technology to cooperate with the front-end development language to complete the front-end information display and uses the Hibernate management system to interact with the database. Through Spring the business logic of pages and data is controlled to realise the information tracking function of this system. The background mainly uses High-arts and Display tag to statistically manage the information visited by children so that the psychological teacher can find the latest situation of the children in a timely manner.

The system can be entered and operated by three roles: children, teachers and administrators. Users can select roles according to their actual situation by clicking the [Login] button to log in and clicking the [Logout] button to reset the current login information. Taking ordinary children as an example, the operations that can be performed after logging in are as follows: (1) View or modify personal information: View your basic information and modify the login password. (2) Fill in the psychological barometer: According to the psychological barometer provided by the system, choose the one that suits your current psychological confusion. (3) Send a private message to the psychology teacher: If you just want to communicate with the psychology teacher alone, you can write down your inner feelings here. In addition to sending this information to the psychology teacher in this system, it can also be sent to the teacher's QQ mailbox through the system. When the psychology teacher does not log in to the system, this information can also be processed in time.

In addition, in this interface, children can also use the floating panel on the right: psychological knowledge, psychological topics, system announcements and message boards.

Take the use of the message board as an example, select [Message Board] on the right side of Figure 8, enter the message display page, click the [All Messages] button to find out all the message information, and click the [My Messages] button to find out the message of the current operator; click the [Publish] button to submit the message; click [Delete] to delete the corresponding message; click the [I also say a sentence] text field to enter

the display page, and click the [Reply] button to respond to voicemail [8].

Fig. 8 Is there any missing figure in this manuscript?: “Take the use of the message board as an example, select [Message Board] on the right side of Figure 8, enter the message display page, click the [All Messages]”

4 Discussion

According to the above experimental data parameters, the big data classification performance of this system, the big data classification system based on Web data, and the big data classification system based on orthogonal

Table 1 Big data classification processing results based on Web data system.

Serial number	Big data classification accuracy rate	System data recall rate	Big data classification prediction value
K1	89.32	90.28	91.63
K2	88.67	90.56	90.82
K3	89.11	90.45	92.42
K4	87.59	90.13	90.29
K5	86.73	90.74	90.78

Table 2 Big data classification processing results based on orthogonal decomposition system.

Serial number	Big data classification accuracy rate	System data recall rate	Big data classification prediction value
K1	85.74	91.55	89.52
K2	86.53	90.26	90.46
K3	89.59	90.13	91.58
K4	88.23	90.75	90.66
K5	86.82	90.39	90.17

Table 3 Big data classification processing results of the system in this paper.

Serial number	Big data classification accuracy rate	System data recall rate	Big data classification prediction value
K1	95.24	98.72	95.13
K2	96.87	99.15	97.25
K3	95.36	99.32	95.37
K4	97.25	98.49	98.56
K5	98.83	97.64	98.64

decomposition are compared. The experiment uses three systems to classify the experimental big data [9]. The big data classification results obtained by the three systems are shown in Tables 1–3.

It can be seen from Table 1 that in the 5 tests based on the Web data system, with the increase of the number of experiments, the accuracy of big data classification and the prediction value of big data classification did not increase significantly, and the system data recall rate has been around 90% [10]. It can be seen from Table 2 that in 5 tests based on the orthogonal decomposition system, the accuracy of big data classification did not exceed 90%, and the data recall rate of the system has also been around 90%, and the prediction value of big data classification is low. It can be seen from Table 3 that the big data classification accuracy rate of the system in this paper is always >95%, and the classification accuracy rate increases with the increase of the number of experiments. The data recall rate of the system in this paper is as high as 99%, and the big data prediction value is high. From the experimental data in Tables 1–3, it can be seen that the accuracy of big data classification and the data recall rate of the system in this paper are significantly higher than the other two classification systems.

5 Conclusion

Based on the actual needs of the current children's mental health, this paper combines IT technology to research and implement the children's mental health information system based on the MVC model SSH framework. The discussion is mainly in the following aspects: (1) The preliminary development of a tracking system for infant mental health information has been completed. (2) Through tracking information services, the interactive capabilities of the system have been enhanced, children's interest in consulting has been stimulated and the practical application of the system has been improved. (3) The system provides a knowledge base query, which not only helps popularise mental health knowledge but also reduces the occurrence of corresponding psychological problems. (4) The system pays special attention to the full exchange and communication between the consultant and the tutor.

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