Design of Online Education Decision Support System Based on Machine Learning

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Abstract. In view of the increase in the number of users in the traditional online education decision-making system, it is difficult to maintain a high level of practicality in long-distance communication. For this reason, the design of an online education decision support system based on machine learning is proposed. In the hardware design, the embedded SRAM is designed as the Cache of the system chip, and RS232 is used as the main communication chip; in the software design, based on the online education of multiple users, the online education support relationship model is designed, and the multi-objective online education decision-making is realized based on this model stand by. The experimental results show that the designed online education decision support system based on machine learning has stable long-distance communication, high maximum resource utilization, and its practicability has been improved.

Keywords: Machine learning · Online education · Decision support · Educational resource management

1 Introduction

The decision support system is a comprehensive computer system and related toolkits that assist managers in making decisions and solving problems. It is a PC application management system with a human-computer interaction interface and a semi-structured body with decision-making properties [1]. Its ultimate purpose is to improve the decision-making process by providing specific information needed for management, and it is an advanced information management system produced by the development of a management information system to a higher level [2].

Today, when information technology is widely used in the field of education, managers, teachers and learners who are responsible for decision-making are experiencing the experience of being submerged by the ocean of data, including education statistics, student statistics, and various social For surveys, examinations and assessment of information, decision makers "submerge in a sea of data, yet endure the thirst for information." A decision support system that integrates data mining technology can provide some help to solve this problem.

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At present, the auxiliary decision-making system is developing rapidly abroad, which has attracted the special attention of foreign experts, especially educational scientists, who have invested a lot of effort in research, and some important academic groups have attached great importance to this system. For example, the International Information Federation not only organizes special academic conferences to discuss this topic, but also organizes and publishes special conference proceedings and sets up a special working group. In foreign universities, for example, the information retrieval system developed by the Technical University of Berlin not only uses fuzzy information processing methods to classify and queue retrieval objects, but also provides an interface for users to evaluate retrieval results and use the results as a basis. A new retrieval and sorting method is formed and stored in the system, which can be used directly next time [3].

In domestic distance education, decision support plays a very important role in online education. At this stage, many schools have applied online education decision support systems to meet their own needs, solving many problems in teaching management [4]. However, with the rapid development of information today, traditional online education decision support systems can no longer meet the actual needs of colleges and universities. With the increase in the number of students and the shortage of educational resources, traditional web-based online education decision support systems and cloud computing-based When the number of users increases, the online education decision support system is difficult to maintain a high level of communication quality, the resource utilization rate in decision support tasks is insufficient, and its overall practicality is relatively poor [5]. Therefore, an online education decision support system based on machine learning is proposed. The software design of the online education decision support system is realized through the design of embedded SRAM applications and communication functions, the online education support relationship model is designed, and the machine learning algorithm is used to achieve multiple Target online education decision support.

2 Hardware Design of Online Education Decision Support System Based on Machine Learning

The hardware design of the online education decision support system based on machine learning mainly includes two parts: the design of the embedded SRAM application program and the design of the communication function module. The following two parts are leased and designed.

2.1 Embedded SRAM Application Design

Embedded SRAM can greatly reduce the data exchange behavior between the embedded microprocessor and the off-chip memory, which not only speeds up the processor fetching instructions and data, but also reduces the number of times to access the external memory, thereby improving the overall system performance. Embedded SRAM applications in system chips can be roughly divided into two categories, one is as an on-chip cache (Cache), and the other is as a temporary memory Scratch-Pad memory (SPM) [6].

The access of the embedded microprocessor to the memory bank is not arbitrary and random, but has obvious regional characteristics. The analysis of a large number of typical program operation conditions shows that in a short time interval, the program addresses are usually concentrated in a small range. This is because the distribution of instruction addresses is originally continuous, and in addition, the cycle program segment and subprogram segment must be Repeated operation for many times, the access to these addresses must have a tendency of centralized distribution in time [7]. Therefore, in a small space-time range, the next instruction to be executed and the data to be processed are most likely to be in the vicinity of the previous instruction or data. This frequent access to the memory in the local range is called program/data Locality of the visit. Based on the principle of locality, a composite storage system can be constructed, including an on-chip memory with a small capacity but fast speed and a main memory with a large capacity but slow speed [8]. The small but fast on-chip memory is Cache, which can automatically save copies of instructions and data frequently used by the processor. The effectiveness of Cache depends on the spatial and temporal locality of the program. Cache and its control components and main memory together constitute an efficient Cache-main memory composite memory. In the Cache-main memory composite memory, programs and data are stored in the main memory. Cache only stores a copy of some programs and data blocks in the main memory. This block-based storage method is also based on the locality of program access [9]. The programs and data blocks in the Cache make most of the information that the embedded microprocessor needs to access have been stored in the Cache, and the read and write operations of the embedded microprocessor are mainly carried out between the embedded microprocessor and the Cache. When the embedded microprocessor accesses the storage level, it must determine whether there is a copy in the Cache. If there is a copy, it is called a hit, otherwise it is called a miss. When the Cache hits, read and write operations to the Cache immediately; when it does not hit, the embedded microprocessor directly turns to access the main memory. Cache is often used in conjunction with write buffer (write bui)er. The write buffer is a very small first-in first-out (FIFO) memory located between the Cache and the main memory. Its purpose is to free the processor core and Cache from slower main memory write operations.

The SPM is directly connected to the processor through the on-chip high-speed bus, occupies an address space exclusively, and stores some instructions and data. When the processor needs to read instruction data, it first determines the address space to select SPM or SDRAM. The former operates directly, while the latter requires access to SDRAM through an external memory interface module, which requires time sequence waiting and off-chip bus drive, which greatly affects system performance. Compared with SPM, Cache is more suitable for use in online education decision support systems.

2.2 Communication Function Design

In the system hardware design, the communication circuit is mainly designed and other parts are optimized for anti-interference. In the design of the remote communication function, RS232 is used as the main communication chip, which can be used at a data transmission rate of 0 to 20000 bps, while ensuring good communication quality [10]. For common control lines such as CTS, DTR, RTS, DSR, etc., the chip has an effective signal range between +3 V and +15 V. RS232 connector generally has three kinds of DB-9, DB-25 and DB-15 [11]. The DB-9 connector is used in the system remote communication, and the definition of each pin is shown in Table 1.

Table 1. RS232 pin definition

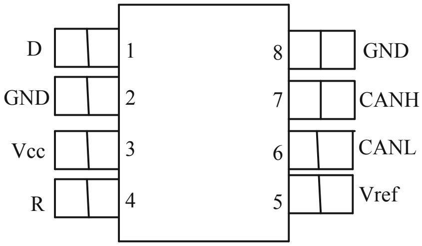
Pin number	Function description	Abbreviation
1	Data carrier detection	DCD
2	Receive data	RXD
3	Send data	TXD
4	Data terminal	DTR
5	Signal ground	GND
6	Data equipment	DSR
7	Request to send	RTS
8	Clear to send	CTS
9	Ring indicator	BELL

The serial communication protocol is mainly adopted in the system communication process to unify the data format and transmission parameters of both parties to ensure that the communication between the two parties is effective. The main parameters to be set are baud rate and data bits [12].

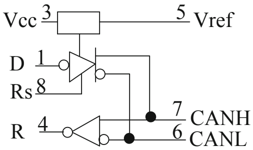
With the support of the RS232 serial port, the CAN communication implementation plan is designed. The core chip of the communication module is SN65HVD230, which mainly realizes the transmission and reception of data and signals. The device has good anti-interference ability [13]. Its pin arrangement and logic functions are shown in the Fig. 1 shown.

The device has good transceiver performance and different working modes at different speeds. The working modes are mainly divided into three types: high speed, slope and waiting. In actual work, the adjustment of the working mode can be achieved through the level of the Rs pin. The control logic of SN65HVD230 is shown in Table 2.

In the table, "?" means undecided state, Z means high resistance state, and X means irrelevant. In order to ensure that the communication maintains a high level and high quality even when the impedance is not continuous, two resistors are connected at both ends of the CAN bus to match the bus impedance with a resistance value of 120 [14].



(a) Pin arrangement of SN65HVD230



(b) The logic function of SN65HVD230

Fig. 1. SN65HVD230 pin arrangement and logic function diagram

Table 2. Control logic of SN65HVD230

Send					Receive		
EnterD	Rs	Output		Bus state	Differential input	Rs	OutputR
		CANH	CANL				
L	VRs ≤ 1.2V	H	L	Dominant	VID ≥ 0.9V	X	L
H		Z	Z	Recessive	0.5V < VID < 0.9V	X	?
OPEN	X	Z	Z	Recessive	VID ≤ 0.5V	X	H
X	VRs ≥ 0.75VCC	Z	Z	Recessive	OPEN	X	H

The reliability of communication is determined by many factors. For the improvement of anti-interference performance, certain anti-interference measures are taken in the power supply [15]. Because different modules within the system require different voltages, the required voltage is provided by a voltage regulator chip, and a switching power supply is used to power the system. On the one hand, it suppresses the noise that the load motor may generate, and on the other hand, it suppresses the instantaneous interference caused by the sudden change of the AC grid load. On this basis, add a filter at the power input to reduce noise or other interference. So far, the design of the hardware part of the system is completed, and the software part of the system is designed according to the actual needs of the user for the system.

3 Software Design of Online Education Decision Support System Based on Machine Learning

3.1 Design Online Education Support Relationship Model

In the entire online education decision support system, it is necessary to clarify several support relationships in the learning support process. This relationship will be the basis for establishing connections between various modules in the system.

According to the difference between the support provider and the recipient, we can get the support relationship in Table 3.

Table 3. Support classification in online education decision support

Provider	Recipient	Support type
Subject teacher	Student	Subject support
Manager	Student	Non-disciplinary support
Student	Student	Subject support
School institution	Subject teacher management staff	Meta support
Support students	Support staff	
Student	Subject teacher management staff	Backfeeding support

Subject teachers' support to students. This kind of support relationship is called subject support in the literature of distance education, and it has always been the focus of study support research.

Support for students from teaching management staff. In the distance education literature, this type of support is called non-disciplinary support. Due to the humanization of distance education in recent years, this type of support relationship has also received attention in recent years.

Mutual support between students. This type of support relationship is rarely discussed in traditional learning support theories, and it is probably more troublesome to realize this type of support relationship in the previous form of distance education. However, with the development of network communication technology, the realization of this type of support relationship appears to be very simple. At the same time, with the development of collaborative learning theory, the importance of this type of support has begun to emerge, and this type of support is also very concerned in this research. Support relationship.

School-running institutions provide support for subject teachers and teaching administrators. This type of support relationship is called "meta-support". It does not directly support students. However, modern distance education practices show that the necessary training should be provided for teachers and teaching administrators who directly provide learning support. It is an important part of improving the quality of learning support.

Support among supporters. We can classify this type of support as “meta-support”. It is the experience of mutual exchange of learning support between people who provide learning support, and it is also conducive to the improvement of the quality of learning support.

Students’ “backfeeding” to subject teachers and teaching administrators. This kind of support relationship is very peculiar. Its support direction is exactly the opposite of the traditional learning support direction. Its actual situation is that subject teachers and teaching administrators have learned some relevant things from students. According to these five support relationships, a relationship model for online education decision support can be obtained.

3.2 Multi-objective Online Education Decision Support

Based on the above-mentioned decision support relationship model, a multi-objective multi-objective decision-making model is established. Assuming that the set of decision-making methods for a certain problem of online education is $W = \{W_1, W_2, \ldots, W_n\}$, its purpose is to select the best plan from the n plans, and set the attribute of the essential characteristics of the response plan to α, with multiple levels, each level is the current The attributes of the level, the evaluation index of the next level, the attribute set of the first level is $G = \{G_{\alpha 1}, G_{\alpha 2}, \ldots, G_{\alpha n}\}$, and the attribute set of the next level is:

$$\begin{cases} G_{\alpha 1} = \{g_1, g_2, \ldots, g_n\} \\ \ldots\ldots \\ G_{\alpha n} = \{g_1, g_2, \ldots, g_n\} \end{cases} \tag{1}$$

By analogy, the attribute values at all levels of the multi-objective decision-making scheme are obtained. In the decision-making process, a group of experts composed of m experts scored plan set W, and the experts’ scores on each attribute of the n plans were obtained, and the decision attribute matrix U of each expert for n plans was obtained:

$$U = \begin{bmatrix} U_{1m_1} & U_{1m_2} & \ldots & U_{1m_n} \\ U_{2m_1} & U_{2m_2} & \ldots & U_{2m_n} \\ \ldots & \ldots & \ldots & \ldots \\ U_{nm_1} & U_{nm_2} & \ldots & U_{nm_n} \end{bmatrix} \tag{2}$$

Matrix U is a multi-level, multi-attribute multi-objective decision-making judgment matrix. When solving the decision problem, the decision matrix W is normalized to $R = \left(r_{ij}\right)_{mn}$, namely:

$$R_{ij} = \begin{bmatrix} R_{11} & R_{12} & \ldots & R_{1n} \\ R_{21} & R_{22} & \ldots & R_{2n} \\ \ldots & \ldots & \ldots & \ldots \\ R_{m1} & R_{m2} & \ldots & R_{mn} \end{bmatrix} \tag{3}$$

In the above matrix, R_{ij} is the attribute of the plan set. According to the normalized matrix obtained, the multi-objective comprehensive evaluation value of each decision plan is calculated, and the ranking is based on the score to obtain the best decision plan result. So far, the design of an online education decision support system based on machine learning is completed.

4 Experimental Research on Online Education Decision Support System

4.1 Experimental Platform Construction

In the experimental research on the online education decision support system, the CloudSim simulation platform was selected as the online education project simulation platform, and the designed machine learning-based online education decision support system, the traditional web-based online education decision support system and The online education decision support system based on cloud computing manages educational resources and supports decision-making, verifying the actual performance of different decision support systems under the same experimental conditions. The basic process of CloudSim simulation platform is shown in Fig. 2.

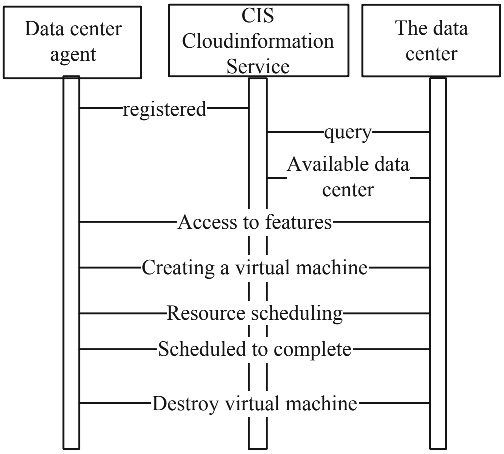


Fig. 2. CloudSim simulation platform construction process

Set the relevant parameters of the experiment before performing the experiment.

4.2 Experimental Parameter Settings

The virtual machine resource related parameter settings in the CloudSim simulation platform are shown in Table 4.

Table 4. Virtual machine resource parameter setting table

Numbering	Processor	RAM (MB)	Bandwidth (Kbps)	Security level
000	4	2048	500	{3, 5, 2}
001	2	2048	1000	{5, 3, 1}
002	1	2048	1000	{1, 2, 5}

(*continued*)

Table 4. (*continued*)

Numbering	Processor	RAM (MB)	Bandwidth (Kbps)	Security level
003	4	1024	800	{2, 3, 4}
004	4	1024	500	{4, 4, 5}
005	1	1024	600	{3, 4, 5}
006	2	512	700	{3, 4, 5}
007	1	1024	600	{3, 4, 5}
008	2	512	700	{2, 4, 5}
009	1	2048	1000	{1, 2, 5}

In the experiment, an online education decision support example is used to illustrate the actual performance of the designed decision support system and to verify its maximum resource utilization rate and communication signal stability. The resource parameters of each task of the electronic engineering project simulated by the experiment are shown in Table 5.

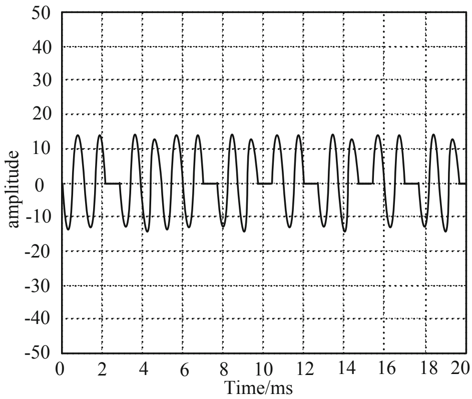
Table 5. Online education decision support resource parameter settings for each task

Task number	User number	Emergency task	Resource demand per unit time
S	249	–	(0, 0, 0)
A	193	S	(4, 5, 7)
B	157	S	(2, 3, 4)
C	56	A	(4, 5, 6)
D	89	S	(1.1.2)
E	182	A, B	(3, 3, 4)
F	261	G, H	(4, 4, 6)
G	308	F	(2, 2, 3)
H	409	C, E	(3, 2, 6)

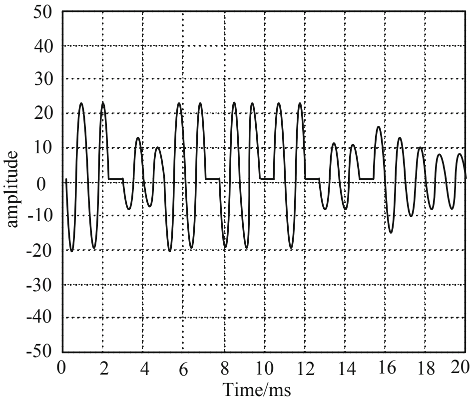
After completing the above parameter settings, run different decision support systems to perform tasks, and compare the actual performance of different decision support systems with the goal of completing the communication stability and maximum resource utilization of the decision support tasks.

4.3 Remote Communication Experiment Results and Analysis

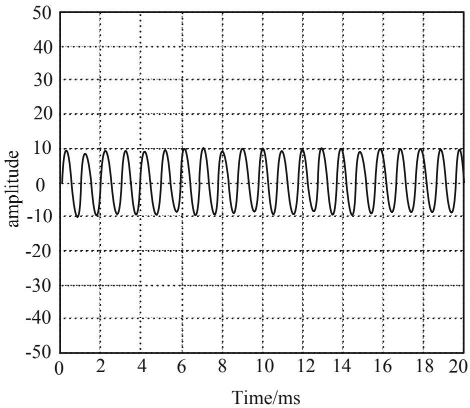
Use third-party software to monitor the communication process of different decision support systems, and output the signals generated by the system during the execution of decision support tasks to the interactive interface. The specific results are shown in Fig. 3.



(a)Experimental results of web-based decision support system



(b)Experimental results of decision support system based on cloud computing



(c)Experimental results of decision support system based on machine learning

Fig. 3. Experimental results of communication stability of different decision support systems

Comparing the results in the observation graph, it can be seen from Fig. 3(a) that the signal is not continuous within the effective experimental time, and there is a short stagnant hole in the middle; the result in Fig. 3(b) shows that the signal is not only discontinuous, but the amplitude The size change is not stable; the result in Fig. 3(c) shows that the signal amplitude changes within a fixed range, and is always continuous and uninterrupted. In summary, the designed online education decision support system based on machine learning has more stable signals and better communication effects in long-distance communication.

4.4 Experimental Results and Analysis of Maximum Resource Utilization

According to the above results, the maximum resource utilization of different methods is calculated, and the calculation results are shown in Table 6.

Table 6. Calculation results of maximum resource utilization

Method	Number of tasks in parallel	Maximum resource utilization
Web-based online education decision support system	6	54.92%
Online education decision support system based on cloud computing	7	69.36%
Online education decision support system based on machine learning	10	99.62%

It can be seen from the calculation results of the maximum resource utilization rate in the table that the designed decision support system has a large number of concurrent tasks and a high maximum resource utilization rate. Combining the above experimental results, it can be seen that the designed online education decision support system based on machine learning has stable long-distance communication, which can ensure that all resources are fully utilized in resource decision-making and avoid resource waste. The system is superior to traditional online decision-making systems.

5 Conclusion

This paper studies and designs an online education decision support system based on machine learning. After the design is completed, a number of comparative experiments have proved that the designed decision support system is more practical and solves the problems existing in traditional decision support systems. It provides certain technical support for future online education.

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