Acta Technica *62* (2017), No. 7A, 451–462

Design of sports training management system based on workflow

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Abstract. The objective is to design and implement a sports training information management system of universities and colleges. On the premise of A Wed-based sports training information workflow management system of universities and colleges is designed and implemented under the premise of current Wed development and according to the requirements for information-based sports training management, in which case Java is used as the development language and reference is made to c/s access architectural pattern. With **Activiti5 workflow engine**, both the developers and the business personnel are able to build a BPMN2.0 compliant process model in the browser. The design and optimization of the workflow-based sports training management system is then performed by Hibernate framework and discrete Hopfield neural network. The results show that sports training information management system developed and designed based on Web enables professional athletes to query the information on sports training program of universities and colleges through Web so as to achieve optimized and innovative sports training information management.

Key words. Workflow, sports Training, Management system, Wed development.

1. Introduction

With the booming of the nationwide fitness campaign, great changes have taken place in the attitude of people towards life. In some middle-/big-sized cities, consumption for fitness has been a fashion item to improve the quality of life in the new era. The nationwide fitness campaign has also been a long-term state policy in China. Statistics show that the overall physical fitness of the masses in China tends to decline, where university and college students experience the greatest decline in their physical fitness. Chinese government has paid high attention to such a troubling issue by issuing many supporting policies and countermeasures as a response. However, the outcome is not so good. There are many factors of which one of the most important is insufficiently scientific development of sports training program and methods. The varying levels of PE teachers lead to much subjective consciousness in the development of sports training program and methods. The failure to effectively develop a targeted scientific prepared program and methods according to the individual physical fitness of students results in low initiative of students to participate in sports training and poor

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training results, which hampers the effective development of students' physical fitness to a certain extent.

The decision support system (DSS) was first presented by M.S.ScottMorton, professor of Massachusetts Institute of Technology (MIT) in the 1970s. Among so many intelligent information technology, DSS is applied to the program, training, routine management and other fields of sports activities. Much practical experience and many achievements have been obtained in the process of practice systematic application, developing the original two-library structured DSS to an intelligent DSS integrated with artificial intelligence. This is a long process of development. The occurrence of the intelligent decision system not only arouses wide attention from the people but also turns to be a hot topic in the scientific researches of the industry and even countries all over the world. Most of existing intelligent decision systems provides scientific and rational decisions for users by using scientific and theoretical methods and by means of the man-computer interactions. However, the researches of world experts and scholars in the field of sports training management are only limited to an athlete or individual sports. There are few researches on the professional and intelligent decision system that improves the physical fitness of university and college students.

The present paper designs and implements a Wed-based sports training information workflow management system of universities and colleges to address several issues in current sports training management. It is to help them develop the scientific and effective sports training program and methods for university and college students.

2. Description of sports training management system design

2.1. Requirements of system design

In the sports training information management system of universities and colleges designed, Web as the basis should be able to improve the development technology and system functions in order to enhance the serviceability of sports training information system in practice and achieve the ultimate goal of promoting the use of such system. Wed mobile device will be used the sports training information management system designed. Given the requirements of most sports fans, application of such system to better manage sports training information will be possible. The design of the system should maintain easy to use with consideration of actual requirements of users and based on the actual training habits of sports fans. The workflow of the whole procedures should be streamlined. The interface design should be simple. The navigation should also be proper. All these will provide most sports training users with good experience and design. In the system design, the expandability of the system should be improved based on Web; on this account, modular philosophy of design should be used in the design of Wed sports training information management system. This is to facilitate future upgrading and expansion of the system functional modules and ensure the upgrading and maintenance of the system in future applications will meet the requirements. In the system design, users will gain access to the sports training information management system through Web. The availability of the system design should be enhanced in order to comply with the usage requirements of users.

2.2. Overall structural design of system

The sports training information management system will be designed based on Wed. For the overall system structure, the design layout of the overall system structure will be made according to the requirement analysis factor and by using C/S access pattern. It is to ensure that system users will gain access to the system only by downloading Wed client. Sports training learners will have access to the server of sports training information management system by using hotspot, 3G and 4G network techniques, which enables the query of video, text resources in terms of sports training. The overall structure design of the system is shown in Fig. 1.

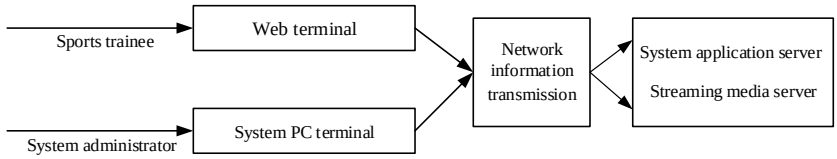

Fig. 1. System design structure

2.3. Functional design of system

For the functions of the sports training information management system designed, the Web-based requirement analysis demonstrates that the sports training information management system should have five functions to be set in different modules, as shown in Fig. 2.

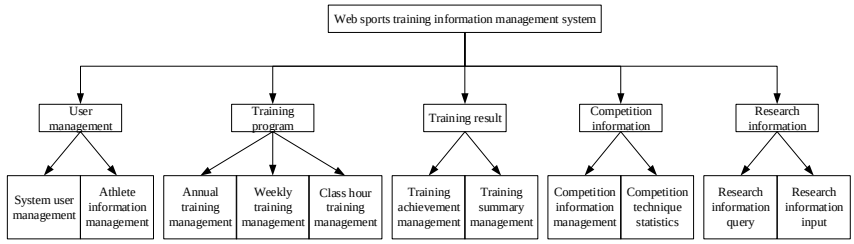

Fig. 2. Functional structure of system

In the present study, scientific management of sports training information and full integration of modern information Wed technique to sports training information management enhances both management efficiency and level. The system functions are as follows:

(1) User management: it allows the management of registration and sign-in of system users and trainee; additionally, setting of user authority is also allowed in this part to ensure that the information of users in the system is safe.

(2) Training program management: The trainer edits, submits and queries the annual, weekly and period training programs.

(3) Training result management function: it is used to evaluate the results of sports training and manages sports training information and data of users on a staged basis.

(4) Competition information management: it stores and queries the information on sports training and competition, information basic information of sports competitions, participants, results and optimizes the management of sports training information in order to ensure that the specific availability value is enhanced.

(5) Scientific information management: it inputs and stores the training information in the system. It can also initially collect and process the research data in sports training and activities for enhanced the expansion system of the system.

3. Workflow-based system design

3.1. Overview of workflow technique

Workflow is presented for the activities of routines and with fixed procedures. It is initially applied to production organization and office automation. The workflow segments the roles and tasks of work, performs these tasks according to some rules and processes and monitors the performance of these tasks, so as to reduce the production cost, improve work efficiency and enhance the business management level of enterprises and institutions and the competitiveness of enterprises.

Workflow Management Coalition (WFMC) defines workflow that: workflow is the business process of a class that can be automatically implemented in full or in part. It may be transmitted and executed by different executors according to a series of procedural rules, documents, information or tasks. WFMC [13] defines workflow management system that: workflow management system is a software system that defines and manages workflow and advances the implementation of workflow instances according to the predefined workflow logic in the computer. It means that workflow is to implement the business process on the computer, while workflow management system is to provide such implementation with the software environment.

The reference model gives abstract interfaces and components of the workflow management system functions [15], all of which may satisfy main functional characteristics that workflow management products should have and also provide a common basis for interoperation between workflow products. Workflow management system mainly consists of three components: software component - for the implementation of the function of system parts; system control data - the data used by system software component; and application and application data – called by workflow system to perform the management function of part or all of the workflow. In practical system application, workflow management system generally includes three stages: modeling, instantiation and execution. The modeling stage is to turn the business process of an enterprise into a model by using modeling tools, i.e. to turn the actual business operation of the enterprise into a model of workflow available for processing by the computer; the instantiation stage mainly sets the parameter during the operation for each process and assigns the resource required by execution for each activity; and the execution stage performs human-machine interaction and application execution, and also tracks and monitors the execution of the activity and process conditions.

3.2. Activiti5 workflow engine

Activiti5 is a JBPM4-based open source workflow system presented by Tom Baeyens following his employment by Alfresco. This is a business process management (BPM) system for developers and system administrators. The core is ultra fast and stable business process modeling and labeling (BPMN2.0) workflow engine. It is easy for the system to be used with Spring Integration. Activit5 provides the flexible Apache license 2.0 in order to be widely used. It also promotes the matching of Activiti BPM engine with CPMN2.0 [17].

Activiti5 item generally consists of three types of components: dedicated tools, stored content and collaboration tools, as shown in Fig. 3.

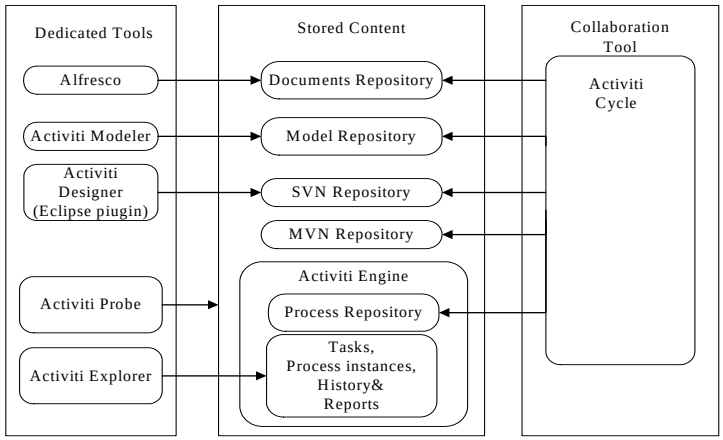

Fig. 3. Activiti components tools

The core components of Activiti5 include: workflow engine (Activiti Engine), Web-based workflow modeler (Activiti Modeler), Eclipse plug-in based designer (Activiti Designer), Web-based management console (Activiti Explorer), collaboration tools (Activiti Probe) and Spring Integration. One of the most important core component tools is its workflow engine (Activiti Engine), which together with other Activiti5 component tools provides an important technique for the design of process management solutions.

With the help of Activiti Modeler, developers and business personnel are able to build a BPMN2.0 compliant process model in the browser. Activiti Designer is an Eclipse-based plug-in tool. The developers design the post-modeling business as BPMN2.0 compliant process all of which can run on Activiti Engine.

In addition to Activiti Modeler and Activiti Designer, Activiti5 also offers Activiti Explorer with Web-based management tool. In Activiti Explorer, users can see all deployed processes or launch a new process instance to view a list of all processes, or manage the list of tasks assigned by the process and operate the task.

3.3. Hibernatye framework

Hibernate is a framework for open source objects and relational mapping that encapsulates lightweight objects in JDBC so that Java programmers can manipulate the database

using the object's programming mindset. Hibernate framework can be used in any scenario using JDBC. It is allowed in Java client program and also in Servlet/JSP Web applications [21]. The most revolutionary thing is that Hibernate framework can be applied in J2EE architecture using EJB as a substitute of CMP to perform the important task of data persistence. Hibernate framework has six core interfaces: Session, Transaction, SessionFactory, Criteria, Configuration and Query, as shown in Fig. 4. These six core interfaces are utilized in any development. With these interfaces, access to persistent object will be enabled, and transaction control will also be performed.

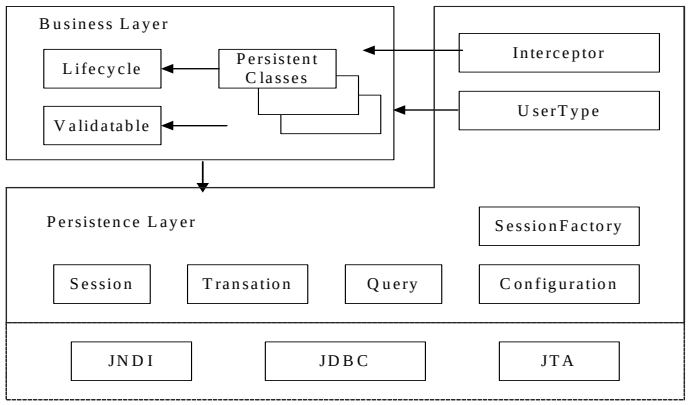

Fig. 4. Hibernate key interface

Session interface is responsible for executing CRUD operation (CRUD) of the persisted object. The task is to complete the exchange with the database. Many common SQL statements are included. However, it should be noted that the Session object is not thread-safe. Hibernate session is different from HttpSession in JSP application. When using the term "session" here, we actually refers to the session in Hibernate. HttpSession object will be referred to as user session at a later date.

SessionFactory interface is responsible for initializing Hibernate. It acts as a proxy for data storage source and creates Session object, in which case the factory pattern is used. It should be noted that a project generally only needs a single SessionFactory. However, when operation of several databases is required, a SessionFactory will be assigned to each database. It is therefore that SessionFactory is not lightweight.

The Configuration class is responsible for configuring and initiating Hibernate, and creating SessionFactory object. In the process of Hibernate initiation, the object instance of Configuration class first locates the mapping document and reads the appropriate configuration, and then creates SessionFactory object.

Query and Criteria interfaces are mainly responsible for executing a variety of queries in related database. They may use either the HQL statement or the SQL statement as the presentation form.

Transaction interface is responsible for operating relevant transaction. It is optional, so developers can design the code for their underlying transaction.

The operational process of Hibernate is shown in Fig. 5. The program first calls the Configration class that reads Hibernate configuration file and mapping file information to

get a SessionFactory object. A Session object will then be generated from SessionFactory object. The Session object will be used to generate the Transaction object. Load, update, store and delete of PO layer are executed by get(), load(), save(), update(), delete() and saveOrUpdate() of Session object. A Query object may be got by the Session object in the query state. Such Query object executes the query operation. The Transaction object submits these operations to the database provided that no abnormality occurs.

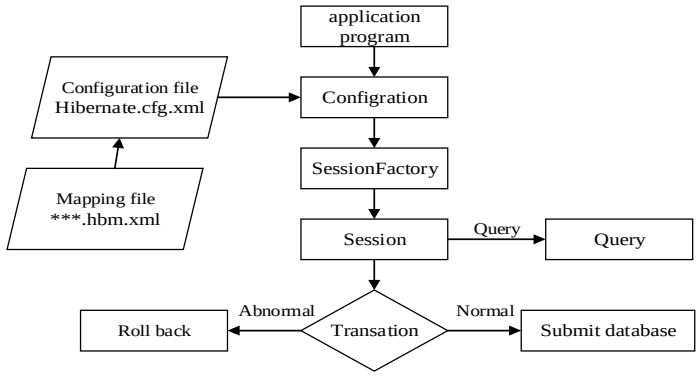

Fig. 5. Hibernate operational process

3.4. Discrete Hopfield neural network

Hopfield neural network is one of the artificial neural network. Artificial Neural NetWorks (ANN) is a new information processing system that simulates the structure and mechanism of human brain. It is not necessary for ANN to understand the details about the internal mechanism of things and the connection right between system input and output. In addition, the wide adaptation, learning and non-linear mapping capabilities have enabled it to receive increasingly more and more attention.

The Hopfield network was first proposed by physicist J.J. Hopfield in 1982. He simulated the memory mechanism of biological neural network, and obtained satisfactory results by using different structural features and learning methods different from the hierarchical neural network. The neural network first proposed by Hopfield was binary, and the neuron output of the neural network had only two values: 1 and -1. It is also called discrete Hopfield neural network (DHNN). Fig. 6 is a map of DHNN network structure that consists of three neurons.

In Fig. 6, layer 0 of the network layer is not a real neuron but input. This is a layer without calculation function. Layer 1 of the network layer is the real neuron. The output of the neurons on this layer is obtained by accumulating the product of the input information and the weight coefficient and then processing it by the non-linear function F again. F is a threshold function. If the value of neuron output information is greater than the threshold, the neuron output will be 1; if not, it will be -1.

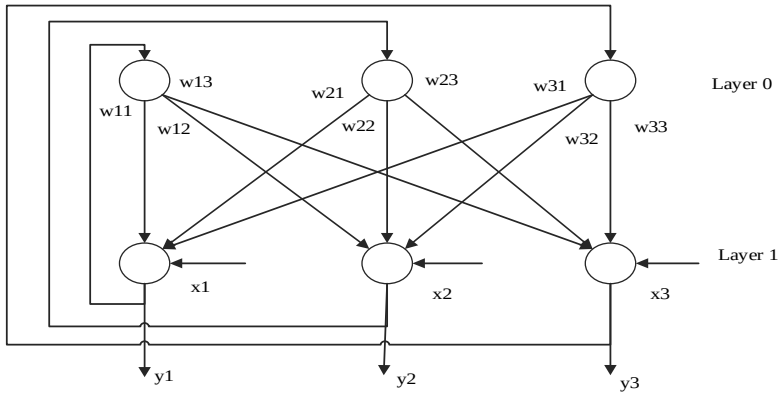

Fig. 6. Discrete hopfield network structure

For such binary neuron, the calculation formula is as follows:

$$u_j = \sum_i w_{ij} y_i + x_j \,. \tag{1}$$

Where, x_j is the external input. There is

$$\begin{cases} y_j = 1, u_j \geq \theta_j \\ y_j = -1, u_j < \theta_j \end{cases} \tag{2}$$

The state of the discrete Hopfield neural network should be a set of output information of all the neurons. If the output layer of the network consists of n neuron(s), the state of the neural network at time t should be an n-dimensional vector:

$$Y(t) = \left[y_1(t), y_2(t), ...y_n(t)\right]^T \,. \tag{3}$$

n-dimensional vector $Y(t)$ has 2^n state(s) as the value of $y_i(t)(i = 1, 2, \cdots, n)$ may be either 1 or -1. That is, the network has 2^n state(s). The state of node j at time t is be expressed in $y_j(t)$. The state of the next moment may be obtained:

$$y_j(t+1) = f\left[u_j(t)\right] = \begin{cases} 1, & u_j(t) \geq 0 \\ -1, & u_j(t) < 0 \end{cases} \tag{4}$$

$$u_j(t) = \sum_{t=1}^{n} w_{ij} y_i(t) + x_j - \theta_j \,. \tag{5}$$

DHNN can be used as an associative repository for associative memory. It can be used as a class of effective classifier. In this paper, the classified samples of sports training courses to be stored is used as the system attractor, that is, each attractor of the system is a class of sports training courses. The specific sports training courses to be classified are taken as the initial input of the system (Hopfield neural network). The process of association is the process in which the input converges toward the class corresponding to the attractor.

Therefore, the classification process can be divided into memory and association stages. The memory stage is to set a series of weights for the network so that the network has a number of stable and equilibrium state can; it may also be called network system attractor. The association stage is that the network gets the given input pattern to the stable and equilibrium state through the evolution of dynamics, i.e. the process of converging to the system attractor [26].

4. Experimental analysis

The evaluation indexes to which several typical classification levels correspond are designed as the equilibrium points of DHNN. DHNN learning process is the process that the evaluation indexes of the typical classification levels keeps approaching to DHNN equilibrium points. After learning, the equilibrium points stored in DHNN are the evaluation indexes corresponding to each classification level. The evaluation indexes of the sports training courses to be classified are input to DHNN network where DHNN keeps approaching to an equilibrium point stored in the network by using its associative memory ability. The corresponding equilibrium point is the classification level to be obtained when the state no longer changes.

(1) Design of desired evaluation index

First of all, 16 kinds of sample data collected are preprocessed and converted to the interval [0,10] according to $\frac{x-\min}{\max-\min}\times 10$. With expert assessment, the sports training courses are divided into A (very important), B (important), C (generally importance) and D (not important) levels to assess the importance of such sports training courses to coal mining enterprises. Table 1 shows the sample data and expert evaluation indexes.

Table 1. Correspondence between evaluation indexes and expert assessment

No.	X1	X2	X3	Y1	Z1	Z2	Expert Assessment
1	8.6	9.2	9.1	8.6	9.2	9.1	A
2	9.2	8.5	9.3	8.1	8.1	9.8	A
3	4.1	4.9	5.8	5.1	4.9	4.8	C
4	6.6	7.6	7.1	7.6	7.6	6.1	B
5	6.5	7.5	7.3	7.5	7.5	5.3	B
6	4.1	5.9	5.8	4.7	3.3	4.8	C
7	2.1	3.7	2.9	2.1	3.7	1.9	D
8	8.3	8.0	9.1	9.3	8.0	8.1	A
9	4.7	4.9	5.2	4.7	4.6	4.2	C
10	2.3	2.2	3.7	2.3	2.2	3.1	D
11	3.4	3.7	2.1	3.4	1.7	2.1	D
12	4.1	5.2	5.1	4.9	5.2	3.1	C
13	3.9	3.1	2.5	2.9	2.1	4.5	D
14	9.1	8.5	9.4	8.1	9.5	8.4	A
15	7.2	6.5	8.0	6.2	7.5	7.0	B
16	7.0	7.7	6.7	6.0	6.7	8.7	B

The average of the samples' evaluation indexes in all levels are used as the equilibrium

point of DHNN; that is the desired evaluation index of all levels, as shown in Table 2.

Table 2. Desired evaluation indexes of four levels

No.	X1	X2	X3	Y1	Z1	Z2
1	8.8	8.55	9.225	8.525	8.7	8.85
2	6.835	7.325	7.275	6.825	7.325	6.775
3	4.25	5.225	5.475	4.85	4.5	4.225
4	2.925	3.175	2.8	2.675	2.425	2.9

(2) Coding of the evaluation index at desired level

The neurons of the discrete Hopfield neural network have only "1" and "-1" states. It is necessary to code in order to map the evaluation index to the state of neuron. Here is the coding rule: when it is less than the evaluation index of a level, the state of neuron will be set to be "-1"; if higher, it will be "-1". Fig. 7 gives the codes of the desired evaluation indexes of four levels. Symbol ○ refers to the state of neuron "-1", and ● refers to the state of neuron "-1".

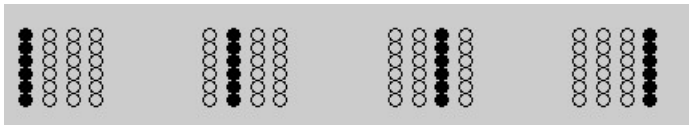

Fig. 7. Desired evaluation criteria of four levels

(3) Coding of evaluation indexes for sports training courses to be classified

Now it is to classify the four classes of sports training courses. The evaluation indexes of these four classes of sports training courses are included in Table 3.

Table 3. Evaluation indexes of four classes of sports training courses to be classified

No.	X1	X2	X3	Y1	Z1	Z2
1	8.3	8.6	9.1	8.7	9.1	8.9
2	6.1	8.6	7.3	7.1	7.4	5.9
3	6.9	6.0	4.9	5.0	5.3	4.9
4	3.1	2.9	3.7	2.7	2.1	3.7

Subject to the said coding rules, the coding of the evaluation indexes of sports training courses to be classified are shown in Fig. 8.

Fig. 8. Coding of the evaluation indexes of four classes of sports training courses to be classified

The discrete Hopfield neural network is subsequently established to classify the sports training courses. The stimulation results in Matlab software is shown in Fig. 9.

Line 1 corresponds to Fig. 7 and represents the coding of four designed separation indexes; Line 2 corresponds to Fig. 8 and represents the coding of the classification indexes

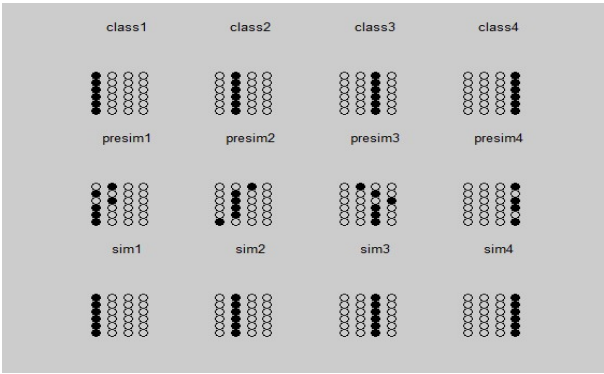

Fig. 9. Simulation results of coding of the evaluation indexes of sports training courses to be classified

of four classes of sports training courses to be classified. Line 3 is the classification results of the designed DHNN. As shown in the figure, the designed DHNN is able to effectively classify the sports training courses.

5. Conclusion

In conclusion, this study designs a sports training information management system based on Web. The sports training information management system is designed and implemented with respect to the pattern of sports training information management in China and as a result of the theoretical preparation, system requirement and system overall structural design, functional design and coding stages. The system will play a practical and valuable role in applications and leave positive influences.

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Received May 7, 2017