

Design and Implementation of a CAI System for Testing the Ability of Ship Engineers(I)

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선박 기관사의 실무능력 평가를 위한 CAI 시스템의 설계 및 구현(I)

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요 약

본 논문은 선박 기관사의 실무 능력 평가를 위한 CAI 시스템의 설계와 구현에 관한 것이다. 지금까지 실무 기관사들을 위한 평가 시험은 주로 필답 시험과 구두 시험에 의존해 왔지만, 컴퓨터를 이용한 CAI 시스템을 사용함으로써 평가에 걸리는 시간을 단축할 뿐만 아니라 효율적인 평가를 할 수 있다. 시스템의 구성은 영역 지식, 질문, 예제 등으로 구성되어 있으며 13 관련 분야에 바탕을 두고 있다. 이 시스템의 사용자는 교사, 실습생, 학생, 선박관련 전문가들이 될 수 있다. 또한 이 시스템을 Client/Server 환경으로 확장하기 위하여 Oracle7.3과 PowerBuilder5.0을 이용한 실험적인 환경을 설계하고 대표적인 Client page를 보여주고 있다.

INTRODUCTION

When hiring ship engineers for posts on vessels it is necessary for the supervisor employed by the ship owner to check up on their knowledge[1]. Usually such work is carried out by the supervisor by means of oral examinations. Given the large number of applicants, this process may be time - consuming and may also appear to be somewhat arbitrary. To overcome these problems, in this paper, we showed a computer program for the ship engineers' automated certificate. This program is based on the

principle of CAI(Computer Aided Instruction).

There is already some employment of computer systems in the shipping field. The well known engine room simulators of the firm "Norcontrol" [2], for example, permit the investigation of the behavior of the marine engineer in the engine room. However this system does not permit the evaluation of all the various kinds of subject knowledge required by the ship engineer.

At the same time there are systems for the checking of knowledge using a computer, enabling the examination of knowledge of one partic-

ular discipline or one subject. This is the system generally called "Control" [3].

The differences of our system from the hitherto existing ones are as follows :

1. This system allows for the testing of knowledge of several different disciplines during a single examination.

2. This system establishes a limited time for responding to the questions in the discipline.

3. This system allows for the formation of the final protocol of the results of the examination of all the disciplines and its preservation in the file on the hard disk.

4. This system employs a graphic mode of formation for windows which permits the creation of a very friendly interface for the user.

5. This system uses a subject oriented base for testing the knowledge of the ship engineers [4, 5, 6, 7, 8].

The developed testing system serves to reduce the labor - intensiveness of the certification process and increases its objectivity. The main purposes of the testing system are :

- To release the teacher or the supervisor employed by the ship owner from routine checks of the training level for an individual who is tested ;

- To give an individual who is trained a means for checking his or her own knowledge ;

- To achieve the maximum co - ordination between an individual's knowlege acquired in high school and that needed in the fleet ;

- To increase the objectivity of knowledge evaluation ;

- To generalize the experience of the testing of knowledge from the various enterprises of a fleet.

The given system is a program product, realized in extended the structure - oriented language of QBASIC version 7.

The program functions in a graphic mode

using a personal IBM computer. Due to the nature of this program an absolute minimum knowledge of the computer is required from the user.

When using this program a distinction should be made among the various users of a system - the operators, the teachers who use the system to check the knowledge of the candidates, and the candidates being tested.

The operator can increase the capabilities of this system by means of the creation and addition of new questions, situational problems, and texts of an educational and informative nature.

Finally, we will suggest a mechanism to extend this system to the Client/Server model using Oracle7.3 and PowerBuilder5.0. This extended system consists of the server which contains the domain knowledge, and the client which contains the application logic.

GENERAL CONSIDERATIONS

The program of certification consists of three logic subsystems. "Environment" - this represents a set of methods and means, executed in language QBASIC, which realizes the main properties of a graphic integrated environment. The main object of "Environment" is a "window", representing a complex object, which possesses structure, which in its turn has data and properties.

The structure of a "window" describes the conditions of an object, which is represented by the following :

1. There is the name preservation file of a background(in amode memory) and each object is numbered ;

2. There are coordinates of the rectangular area of a screen in which a "window" in textual and graphic coordinates is made visible ;

3. Its condition : current, background or trans-

parent.

The functions of a subsystem "Environment" provide for the scheduling of objects. This entails the following :

1. The initialization of the object ;
2. The management of the rules and conditions of the object ;
3. Its interaction with a file disk operating system(DOS) ;
4. The maintenance of a minimum interface with a screen and keyboard ;
5. The restructuring of the object.

"User" – a set of functions, realized in the language QBASIC, of the users presented by subject – oriented interface. This enables the user to solve problems of interaction with the main objects of the program.

The subsystem "User" is executed as a user friendly interface using WYSIWYG "What you see is what you get" by a number selected from a particular menu or dialogue subsystem. These are constructed as extended objects(using functions) of a subsystem "Environment".

The users of a system or the candidate tested have the opportunity to determine the condition of the object by its description on a screen and may choose the necessary conditions of the object, by means of the command "Enter"(to execute).

The main functions of the subsystem "User" are as follows :

1. The registration of the user of a system ;
2. The definition of the user mode to the main resources of a problem ;
3. The registration of any additional information(members of a commission, time of the answer in the mode "Examination", inclusion of the date, and so on) ;
4. The maintenance of a mode "Reference book" by means of a sample of the necessary information of the directory of the subsystem

"Base" according to the choice of the user ;

5. The maintenance of a mode "Examination" by means of a sample of the necessary information of the archive of the system "Base" according to the choice of the user, and the maintenance of the casual character of the representation of the chosen information ;
6. The support of the mode "Examination" by means of a sample of the decisive rules of a subsystem "Base" and answers of the user of a system ;
7. The formation of the protocol for checking the candidate's results by means of the mode "Examination" and the listing of the protocol.

Subsystem "Base" – consisting of a set possessing a file structure which has data sets and decisive rules.

The subsystem "Base" is realized as a subject – oriented list, stored in textual form on the hard disc of the personal computer. The management of the subsystem is executed by means of the lists of the indexes in a textual format.

The subsystem enables the editing of the lists by the various text editors, included in structures of the software of a personal computer(Multedit(ME), Lexicon and others).

THE PROGRAM STRUCTURE

The overall program structure is presented in Fig 1.

When the program is started the subroutines "waitetutor", "reklet", which creates advertising and information helps on a display, subroutine "setmenutxt", "setutil", reading textual information stored in them for windows of the menu and submenu and preserving them as files are consistently executed.

The subroutine "MenuO" creates the main menu and submenus on a screen, supervises the position of the cursor and transmits it via

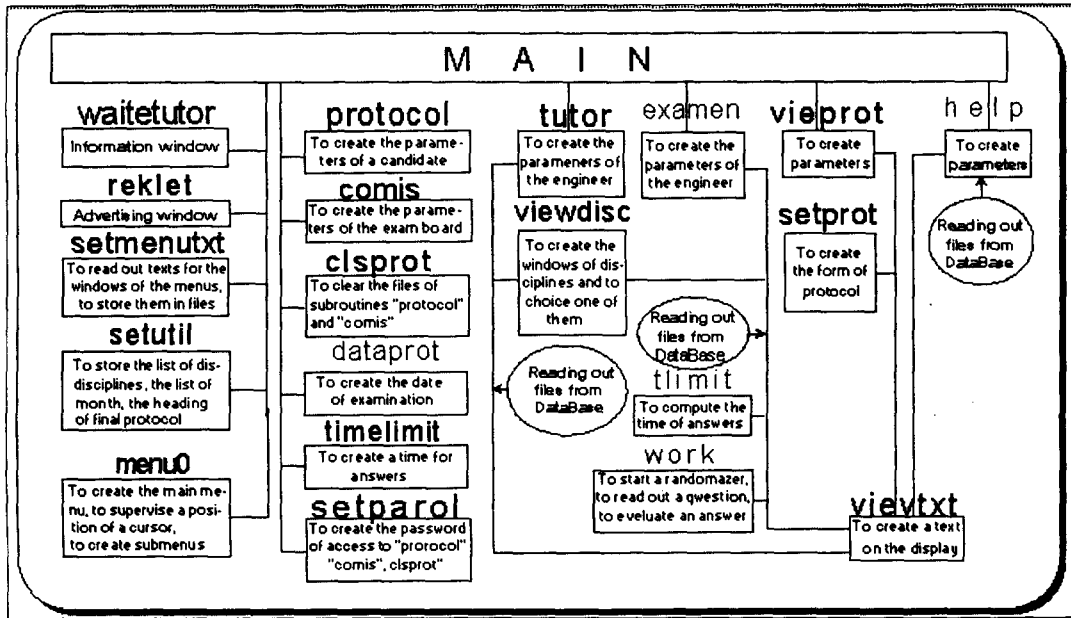


Fig. 1. The overall structure of the program

the "main" module.

The user exits from the menu or cancels an exit by a command which is carried out via the "main" module.

For maintenance, submodes of the mode "Registration" serve subroutines "protokol", "comis", "dataprot", "timelimit", "setparol", "clsprot". Thus the number of the subroutines, forms the parameters for windows, using the subroutine "redtxt". This enables the reading of the text in the windows of the screen.

The mode "Reference book" is executed by the subroutine "tutor", which creates parameters for the particular grade level of the engineer. The subroutine "viewdisc" will organize the viewing of the list of disciplines in the window on the display and allow for the candidate's choice. This is accomplished by the subroutine "tutor" addressing the hard disc and reading out a file from a database. The subroutine "viewtxt" organizes the viewing of the text in the screen window.

The mode "Examen" is executed by means of

the subroutine "examen", which creates parameters for the particular grade level of the engineer, displays the current prompts and provides the results of examination, using the subroutine "qwestsys". The subroutine "viewdisc" organizes the viewing of the list of disciplines in a screen window and allows for the candidate's choice. This is accomplished by the subroutine "exam" addressing the hard disc and reading out a file from a database. The file consists of a blocks of single questions and multiple answers. The subroutine "tlimit" starts the timer which limits the amount of time a candidate may take answering a particular question. The subroutine "work" starts the randomizer and reads out the block of single questions and multiple answers, grades the examination by through the subroutine "vopros". This subroutine shows on a display the block of single question and multiple answers, reads out the position of the cursor and transmits to subroutine "work".

In order for the subroutine "examen" to function the files in the database must have a strictly determined structure. Namely : a key, (in our case a word) ; a colon ; the text of a question in a given language ; and the question mark (?). The answers are formed on a new line. At the beginning they should have a figure with a point. Then on a separate new line a key, a colon and the number of the correct answer.

The mode "Report" is executed by the subroutine "viewprot", which creates the parameters of the protocol. The subroutine "setprot" creates the form of the protocol. The subroutine "viewtxt" will organize the viewing of the text of the protocol in the screen window.

The mode "How to use" is executed by the subroutine "help", which addresses the hard disc and reads out a file from the database. For work with windows, the special library "winlib.bas" has been created. This library allows the opening and closing of windows and the opening and closing of texts. It uses a developed module "winprg.bi" and the module of standard library qbasic - "qbx.bi" and serves to actualize windows, background, and texts.

MODES OF SYSTEM OPERATIONS

1. Main menu

The main menu of the modes of operations with the author's prompt may be seen in Fig. 2. The main menu appears automatically on the display as soon as the program is turned on. The user may then choose among six main modes of operations : "Exit", "Registration", "Reference book", "Examination", "Report", "How to use". The user chooses a function by moving the cursor over it and pressing "Enter". The user can always return to the main menu from any mode or submenu by pressing "Esc".

2. The mode of "Registration"

This mode is intended for the operator of the system, i. e. teacher. After moving the cursor to "Registration" and pressing "Enter", the submenu pictured in Fig. 3 will appear on the screen.

The following seven sub modes of work will be shown : "Registration of student", "Registration of members of examination board", "Date of examination", "To clear report", "Time allowed per discipline", "Save report" and "To set accessibility password".

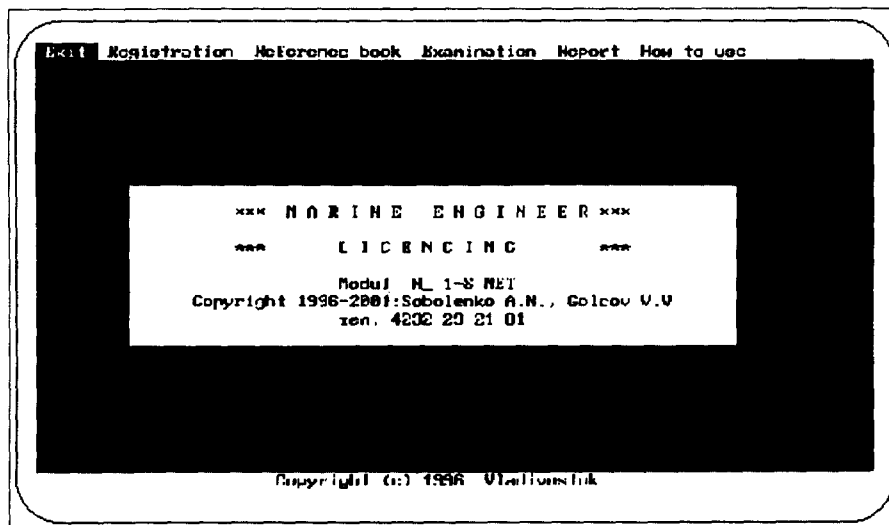


Fig. 2. The main menu of modes

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Registration of student
Registration of members of examination board
Date of examination
To clear report
Time allowed per discipline
Save report
To set accessibility password
    
```

Fig. 3. The submenu for the mode "Registration"

Before the exam begins, the operator should fill out the information in the submenu "Registration" for the operations of a submenu in this mode. It is executed when documenting of results, in a kind of the protocols, is made. If he or she wishes the separate operations in a submenu the operator can also perform it. For example, it is possible to fill out the "Registration of student" submenu while ignoring the other functions. This will be reflected by the final protocol having a blanks in the items not filled out. When this installation is ignored, the answering time for each discipline is automatically set at 10 minutes.

3. The submode of "Registration of student"

After moving the cursor to "Registration of student" and pressing "Enter" the submenu pictured in Fig. 4 will appear on the display.

The text is formed just as in the text editor ME. If necessary the correction of errors can be used. It is not necessary to fill in all the lines.

4. The submode of "Registration of members of examination board"

After moving the cursor to "Registration of

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Surname:
Name:
Second name:
Birthday:
Technical education:
Marine rank in accordance with diploma:
Length of service as a marine officer:
The purpose of test:
To exit press key Esc
    
```

Fig. 4. "Registration of student" form

```

Chairman of the board ...
Secretary of the board ...
1. Member of the board ...
2. Member of the board ...
3. Member of the board ...
4. Member of the board ...
5. Member of the board ...
To exit press key Esc
    
```

Fig. 5. "Registration of members of the examination board" form

members of the examination board" and pressing "Enter", the submenu pictured in Fig. 5 will appear on the screen. It is not necessary that all the lines are filled out.

5. The submode "To clear report"

This mode is used when it is necessary to begin the process of registration again. After moving the cursor to "To clear report" and pressing "Enter", all records in the fields of the protocol form will be erased. No other message will appear on a screen. Usually this command is given when shift student without restarting of the program.

6. The submode of "Time allowed per discipline"

After moving the cursor to "Time allowed per discipline" and pressing "Enter", the submenu pictured in Fig. 6 will appear on the display.

It is not necessary to fill in all the lines. The time allocated to the student to answer each question is set at 10 minutes.

7. The mode of "Reference book"

This mode is intended for the purpose of the candidate's self - preparation. After moving the cursor to "Reference book" and pressing "En-

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Minutes .... 10
Seconds ... 0
To exit press key Esc
    
```

Fig. 6. The form for setting the time taken to answer a questions

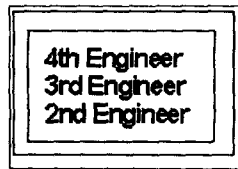


Fig. 7. The submenu "Reference book"

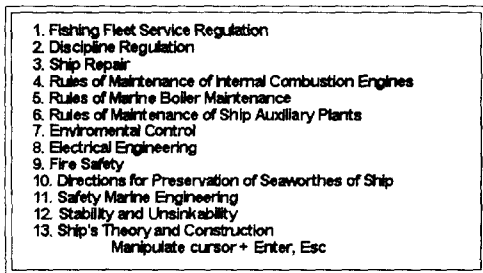


Fig. 8. The menu with the list of disciplines in the submode "4th Engineer"

ter", the submenu pictured in Fig. 7 will appear on the screen. This menu establishes the following three submodes of work : "4th Engineer", "3rd Engineer", "2nd Engineer".

These submenus differ according to their degree of complexity and the volume of the information covered. The list of disciplines is indicated in Fig. 8.

It should be noted that the information given under the submode "2nd Engineer" includes all of the information given in the submodes "3rd Engineer" and "4th Engineer". These files can be supplemented or changed by the operator of the system.

8. The mode "Examination"

This main mode allows the testing of the candidate.

After moving the cursor to "Examination" and pressing "Enter", the submenu pictured in Fig. 9 will appear on the screen.

This submenu allows the user to choose among the following three submodes of work : "4th Engineer", "3rd Engineer", "2nd Engineer". These submodes differ according to the degree

of complexity of the questions and the volume of the material tested. A list of the disciplines which may be tested is indicated in Fig. 8.

It should be noted that it is possible to choose among the items for examination(Fig. 10). Marks obtained for disciplines which are not part of the examination will simply not appear as part of the overall score in the protocol. A symbol which appear in the list of disciplines on the display will indicate where a candidate has attempted a given exam discipline more than once. To select a particular discipline, the user places the cursor on a given item and presses "Enter". Items may be selected as required ; the order of items for testing is not fixed.

After pressing "Enter" a text with a question and set of possible answers will appear on the screen. To select a particular response, the candidate simply places the cursor over that response and presses "Enter".

At this point, a small box will appear in the bottom right corner of the display. This allows the candidate to reconfirm his or her response. By pressing "Enter" the candidate may confirm a "Yes" response. If the candidate wishes to change his or her answer, he or she simply moves the cursor to "No", presses "Enter".

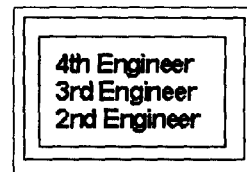


Fig 9. The submenu "Examination"

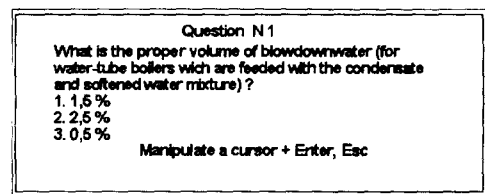


Fig. 10. An example of work in the mode "Examination"

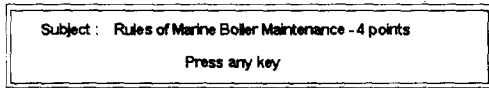


Fig. 11. Prompt of operative grading of the discipline

There are no limits to or penalties for the number of times a candidate reselects an answer except the obvious loss of time itself. When a candidate answers "Yes", the program moves on to the next question.

The question from a file is chosen casually.

Following the conclusion of the test(usually 5 questions), the candidate's total score will appear on the screen(Fig. 11).

9. The mode "Report"

The mode "Report" contains two submodes - "Look through report" and "Print report"(Fig. 12). When the command "Look through report" is selected, the final protocol will appear on the screen. Because the protocol is too large to display all at once on the screen, it is necessary to "scroll up and down" when viewing it. "Scrolling" is executed by using the two keys ↑ and ↓.

The protocol mode is used by the operator to check the certification results. If it is necessary to save the protocol, the candidate or the operator may do this by pressing the "Registration" and "To save the Protocol" keys.

Pressing the "Print the Protocol" key causes the file to be printed out. No preliminary preparation is required when using a dot matrix printer. When using a laser printer, it is necessary to load up a particular font before printing is possible.

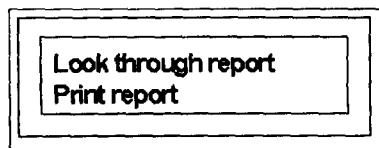


Fig. 12. The submenu "Report"

10. The mode "How to use"

The mode "How to use" presents the text of instructions for working with the program. Because the whole text cannot fit onto the display, it is necessary to scroll up and down. "Scrolling" is executed by the keys ↑ and ↓.

The Extension of this System using Client/Server Model

Even though the current system is based on the principles of CAI whose domain is licencing of ship engineers, there is insufficient idea of intelligence and computer networking . In this section, we will show a methodology to extend this system to the ITS(Intelligent Tutoring System)[10,12,13] and Client/Server model using Oracle7.3[9], PowerBuilder5.0[11], and Information Superhighway.

ITS is an example of the application of artificial intelligence technology to instruction, and the objective of an intelligent tutor is to enable a machine to understand both the concept to be taught and how the student can learn that concept. In this section, we design a prototype of the distant ITS. It is designed for the purpose of testing the knowledge of ship engineers to the candidates using the communication between the candidate and the system which is based on the Client/Server model. There are three models of the distant education. The first one is the educational broadcasting system, the second one is the BBS (Bulletin Board System), and the third one is the video conferencing system which utilizes the Information Superhighway and Local Area Network. We are interested in the third model, and especially the DITS(Distant ITS) model. There are 1 - multimedia server and n - clients in DITS model. The candidates are connected to the multimedia server and navigate the multimedia courseware

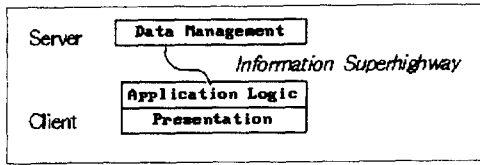


Fig. 13. Remote Data Management

which is constructed in the forms of hypermedia in the server. ITS courseware suggests appropriate questions to the candidates, thus enables them to be tested the proper courses. This model is also based on the Remote Data Management Client/Server model which is one of the five Client/Server information processing models. Fig. 13. shows this model.

The Client searches and updates the Server data using special protocol through the computer network. Remote SQL is an example of this kind of model. Fig. 14 shows the overall structure of the DITS model which is based on the Remote Data Management.

The domain knowledge, that is multimedia data, could be implemented on SPARC station using Oracle 7.3. The application logics could be implemented on Multimedia PC using PowerBuilder 5.0. Fig. 15 shows a typical client page of this system which is implemented on the Multimedia PC using PowerBuilder5.0. This client page utilizes

text and image only. Of course we use some video clips in showing the questions to the candidates.

CONCLUSION

Up to date, the hiring process of the ship engineers is carried out by the supervisor by means of oral examinations. Given the large number of applicants, this process may be time - consuming and somewhat arbitrary. To overcome these problems, in this paper, we showed a computer program for the ship engineers' automated certificate. This program is based on the principle of CAI. And the developed testing system served to reduce the labor - intensiveness of the certification process and increased its objectivity.

The text of the program takes 180 Kilobytes of memory. The program with its files of questions takes 520 Kilobytes in this program.

Finally, we showed a methodology to extend this system to ITS and Client/Server model using Oracle7.3, PowerBuilder5.0, and Information Superhighway. Thus, we could utilize this extended system in the field of distance education and/or that of distributed data base system.

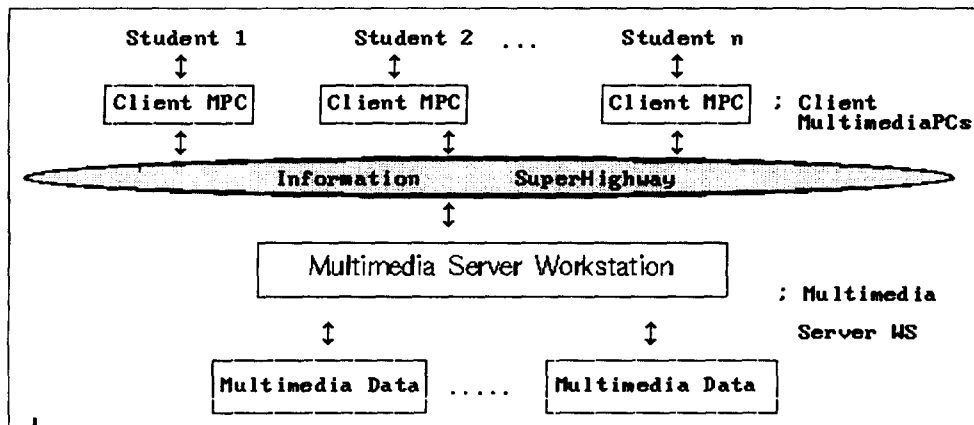


Fig. 14. DITS model based on Remote Data Management

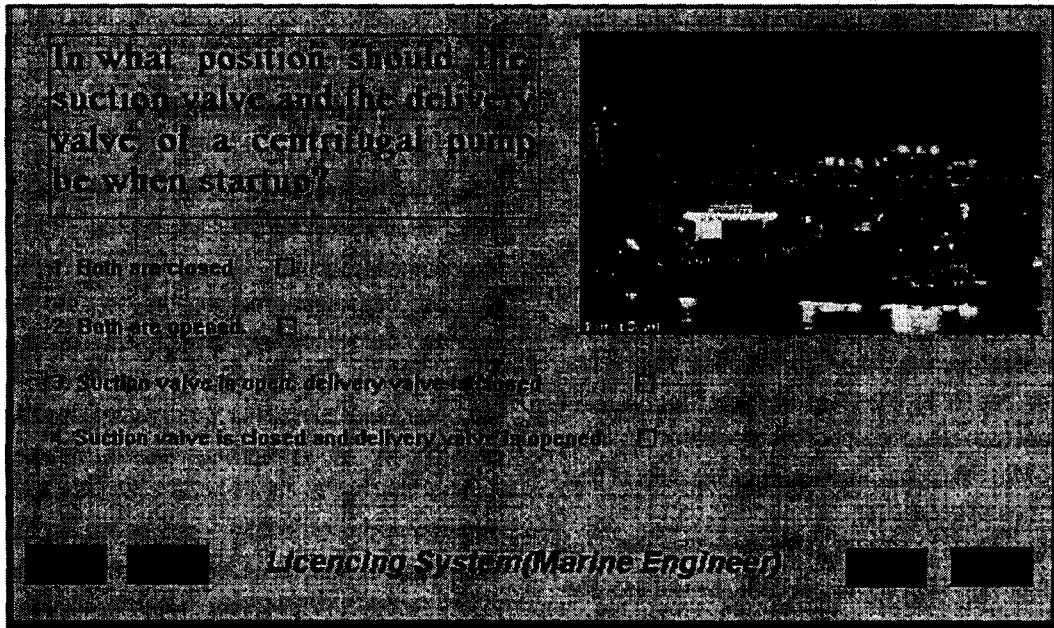


Fig. 15. A client page of the system for the licencing of ship engineers

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