A Virtual Simulation Experiment System for Requirement Analysis

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Abstract: The application of virtual simulation technology promotes the reform of experimental teaching methods in colleges and universities to provide reliable support for cultivating students' professional engineering application ability and improve the overall quality of talent training. Based on real projects, this virtual simulation experiment project adopts the trinity teaching method of 'virtual environment, actual problems, real ability'. And it makes full use of natural language processing and other AI technology and software technology to provide students with requirement analysis experiments that are very close to reality. The practical environment has played a multifaceted effect and solved the students' neglect of the importance of requirement analysis.

Keywords: Requirement Analysis Ability, Virtual Simulation, Teaching Reform, Teaching Application

1. Introduction
Almost no software engineering education in existing colleges and universities has carried out the cultivation of requirement analysis ability systematically. Under the existing software talent training model[1], most of the ability training focuses on programming ability training, especially learning programming language, development environment/framework familiarization, etc.; while the courses involving requirement analysis content are mainly 'software engineering' and 'Requirements Engineering' and so on, but these courses are either very briefly mentioned in the teaching, or more inclined to explain tools[2].

The cultivation of requirement analysis ability is not feasible under the existing teaching mode. Firstly, the cultivation of requirement analysis ability is based on three dimensions of ability (technical
level software engineering ability, business level domain understanding ability and soft skill level communication and expression ability, etc.). Secondly, it needs to find the explicit and implicit requirements in combination with specific projects. The majority of school teaching focuses on the technical level but rarely involving the business and soft skills level, which also leads to a misunderstanding that the ability of system analysis can only be formed in the work after graduation gradually and it is difficult to cultivate in school [3]. Last but not least, factors such as the difficulty of providing the actual project environment and the high cost of experiments make it difficult to cultivate requirement analysis ability under the traditional teaching model.

Considering the importance of requirement analysis ability to software engineering talents, using virtual simulation experiments is an effective way to cultivate the ability of requirement analysis [4]. This virtual simulation experiment project uses the trinity teaching method of 'virtual environment, actual problems, real ability' to fill the gaps in the requirement analysis teaching system. It improves teaching efficiency, stimulates students' interest, and deepens students' understanding of software engineering [5-7].

2. System structure
This system is used to simulate the process of requirement analysis of hospital business platform. Designing and implementing a set of virtual simulation system with student login, management and teaching demonstration functions, and can realize real-time interactive virtual experiments. The system mainly includes: login interface, MENU interface, requirement analysis experiment. The structure of the virtual simulation system is shown in Fig.1.

3. Design of virtual simulation system
3.1. Login UI design
The function of the login interface is to provide users with a convenient, beautiful, and friendly interface. It also protects the privacy of the system to a certain extent because it only provides corresponding services for registered users of the system. The UI design effect of the login interface of the system, as shown in Fig. 2 (translated in English), mainly includes UI graphic controls such as the background, title, mobile phone number/email number input box, password input box, and login button of the login interface. When the entered mobile phone number/email and password have been registered in the system, users can click the login button to jump to the main menu interface for subsequent operations; when the number and password are incorrect, after clicking the login button, a line of red text will be displayed on the screen to indicate that the phone number/email or password is entered incorrectly, and the text will disappear after 5 seconds automatically [8].

![Login Interface](image)

**Fig. 2** The structure of requirement analysis virtual simulation system

Among them, the function codes for logging in and verifying mobile phone number/email and password are as follows:

```java
Login.getInstance()
  .setUserName(inputfieldName.getText())
  .setUserPwd(inputfieldPassWord.getText())
  .setOnLoginState(new LoginState()
      System.out.println("userName:" + userName + "userPwd:" + userPwd + " loginTime:" + loginTime);
    }
  .doLoginCommit();
if (UserDB.USER_NAME.equals(userName) && UserDB.USER_PWD.equals(userPwd))
    loginState.onLoginSuccess(1);
else {
    loginState.onLoginFail(0);
}
setOnLoginState(loginState);
loginInfo.onLoginUserInfo(userName, userPwd);
setOnLoginInfo(loginInfo);
```

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The functions of mobile number/email and password are simplified in this system, and we only research the principle of its verification.

3.2. Virtual simulation ability training design

In order to make the students familiar with the basic process of requirement analysis, for actual software projects, the basic process of requirement analysis is analyzed from the perspective of system designers, covering project background investigation, domain knowledge acquisition, user communication, demand confirmation, etc. The virtual simulation platform exercise students' domain knowledge acquisition ability. In the light of specific domain needs, this platform develops the ability of students to become familiar with the background of the domain quickly, and improves the ability to discover obvious and implicit needs through given data and information retrieval. It also lets students master the common methods and tools of requirement analysis [9]. Requirement analysis requires a high level of comprehensive ability of system analysts. It is necessary to grasp the needs of Party A accurately, and then use relevant requirement analysis tools as a communication bridge to allow Party A to understand whether the analyzed requirements are accurate or not. It is also necessary for Party B to understand the requirements accurately, so that the minor deviations in understanding between Party A and Party B in the requirements analysis stage can be avoided, which may lead to huge misunderstandings in the subsequent stages of design, coding, and implementation [10].

This teaching experiment adopts the trinity teaching method of 'virtual environment, actual problem, real ability', and makes full use of artificial intelligence technologies such as natural language processing and fuzzy matching for process evaluation [11]. The experiment integrates teaching methods and information technology to improve teaching efficiency and actual effects [12]. Regarding the teaching method of the Trinity, the instructions are as follows:

Virtual environment: The 'communication phase' and 'phase review' in the process of requirement analysis in the actual project are simulated in three-dimensional virtual environment, and different scenes are built in it to make the experimenter feel immersive and enhance the sense of reality. Practical issues: This virtual experiment is designed based on the 'Internet Hospital Business Platform Project', which is the core product of Hunan Kintel Information Technology Co., Ltd. It can meet actual needs better and find more real project problems to design experiments with actual products as the object. Real ability: This virtual experiment focuses on ability training, and the assessment of knowledge points is based on problem solving. Different from experimental projects supported by deterministic principles and theory, requirement analysis evaluates from two aspects: process and results, and is more about evaluating the four capabilities mentioned in the signature.

4. Realization of Virtual Simulation System

The requirement analysis virtual simulation system is finally realized on the Educode platform through the above design and research. This virtual simulation requirement analysis experiment design includes a total of 7 experiments. Each experiment will select some key knowledge points in the software requirement analysis process, and examine the students' understanding of relevant knowledge in the form of scenarios and test questions. The final effect of the system is shown in Figure 3 (translated in English). Fig.3 shows the confirmation of software requirements-communication skills with customers.
Teachers can manage the experimental teaching process through the Internet, can set up experimental projects, and review the experimental reports submitted by students. Students can login to the system through the Internet remotely. They can learn the use of virtual simulation software by themselves, complete experiments and upload experimental data independently. Also, they can interact with teachers in the exchange discussion area to answer questions.

![Fig.3 Requirement analysis virtual simulation experiment diagram](image)

5. Conclusion
The purpose of this virtual simulation experiment is to cultivate students' requirement analysis ability. The demonstration design and virtual interactive operation put forward a universal solution, which is simple and fast, and has significant effects. It fills the gap in the requirement analysis experiment. Also, the experimental design of the project has good innovation and strengthens the assessment of soft skills. Virtual simulation experiment teaching has become the development direction of education reform in the information age, and has become an important means for students to acquire knowledge and skills. The simple practical route proposed in this paper has practical guiding significance for promoting the process of reform of simulation experiment teaching.

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