

# AN INTERNET BASED EXAMINATION PLATFORM\*†

Xin Li and Weimin Yan  
Department of Computer Science and Technology,  
Tsinghua University,  
Beijing, China, 100084

## Abstract

An Internet Based Examination Platform (Tsinghua IBEP) for advanced distance learning is described in this paper. The platform was first used in Tsinghua University in July 1999, using TCP/IP as the fundamental protocol. So far more than 10,000 students have used the platform taking examinations of language courses. The strengths of the platform are the flexible architecture supporting various types of examination including computer adaptive tests, and reliable authentication strategy feasible for the formal examinations.

## 1 Introduction

The education innovations based on information and network technology are spreading globally. The way through which people can access education is not limited to the face and face style any longer, and new knowledge-oriented learning style will prevail with everyone's everyday life. In past several years, thousands of people all over the world have finished their formal education through Internet. But most of them must take the examinations which are still based on paper. In this paper, a platform for people to build and take examinations through Internet, which is called "TH-IBEP" (Tsinghua University Internet Based Examination Platform), is described in

detail. The platform has been verified by 10,000 exams/students in language courses in Tsinghua University.

This paper is organized as follows: the specifications of the TH-IBEP are described in terms of state diagram and use case analysis in Section 2. Section 3 will explain the main issues in system design, which focuses on the architecture, ID authentication and examination generation, followed by the conclusion in Section 4.

## 2 Specification of TH-IBEP

The specifications of TH-IBEP including state diagram and use case analysis are described in this section, which reveal the key functions of the platform.

### 2.1 Platform Users

The platform has following three kinds of users:

- Examiners who use the platform to design questions and manage the grades and other information of the students.
- Examinees who take examinations and get the information of the examinations.
- Administrators who manage the performance, configuration and security of the whole system.

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\*Published in Proceedings of International Workshop on Distance Learning and Virtual Campus, November 14-15, 2000, Beijing, China.

†This paper is revised in Dec, 2000.

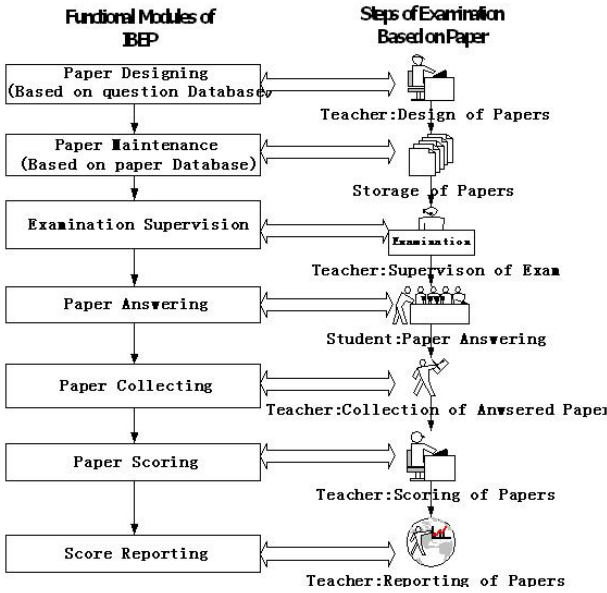


Figure 1: System State Diagram

## 2.2 State Diagram

Compared with the working-progress of the paper-based examination, the state diagram of the Internet-based examination platform is illustrated in Figure 1.

The platform consists of following six functional modules:

- Examination Designing
- Examination Maintenance
- Examination Supervision
- Question Answering
- Paper Collecting
- Paper Grading
- Grades Reporting

## 2.3 User Case Analysis

- For examiners:

1. Questions Creation: different kinds of questions (including selection questions, essay questions, filling questions) can be created and saved in the database.
2. Examinations Generation: given desired difficulty of the examination, total time and other parameters, the platform can generate the examination paper semi-automatically.
3. Paper Grading: The answers will be instantly graded except questions which have to be graded by a human such as essay questions.

- For examinees:

1. Online Registration: the examination can be scheduled online.
2. Question Answering: convenient tools are required to answer questions on line.
3. Instant Feedback: when the answers are graded, the results are required to be sent back instantly.

- For administrators:

1. System Control: monitor the performance of the platform.
2. Users Management: maintain the authorities of the users.

## 3 System Design

In this section, the key issues in platform design are discussed in detail, including the system architecture, identity authentication, and examination generation.

### 3.1 System Architecture

The platform is based on the Internet using “Client/Browser-Application/Web Server-Database Server” three tiers architecture. Subsystems communicate each other through TCP/IP Protocol, in which they use Extensible Markup Language (XML) as the message format. Figure 2 illustrates the architecture of the TH-IBEP.

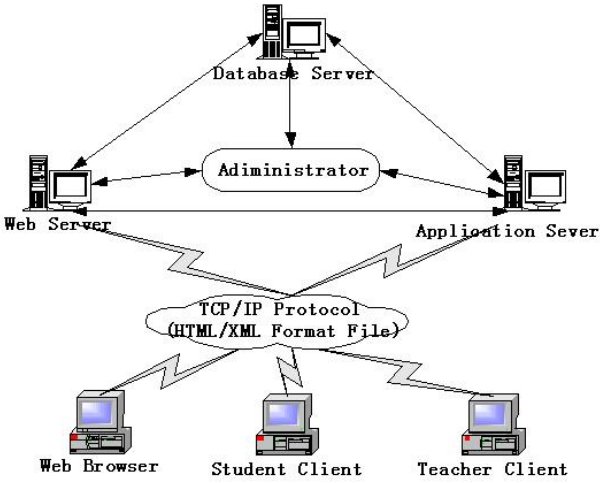


Figure 2: The System Architecture

### 3.2 Identity Authentication

In general, examinations require high security. In our platform, identity authentication of the examinees is one of the most difficult problems. From the view of the security requirement, the examinations can be categorized into following two basic groups:

- Testing Examination
 

This kind of examinations is just for training purpose. Users can choose the examinations and take them as many times as they want, once they are authenticated as valid examinees.
- Formal Examination
 

This kind of examinations is counted as an important evaluation for distance learners. What follows are the two important techniques to ensure the authentication of the identity of the examinees in this kind of tests.

  - IP Restriction
 

The platform provides tools for the administrators to assign a legal range of IP-Address for the examinees' clients, who must use the computer within the IP range to take the test. Usually, the IP range will

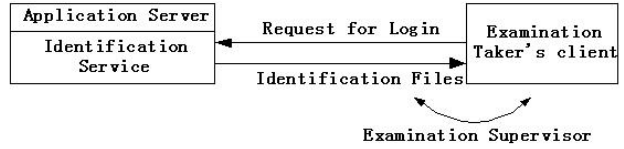


Figure 3: The Process of Identity Authentication for the Formal Examination

map to the computers within the test area in public labs (such as the Open Lab in Tsinghua University).

- Manual Authentication

When the examinees are registering the formal examinations, valid photo IDs and digital signatures are required to provide, which will be kept in the database. After examinees login on the platform to start their examinations, the identification files (including photos and digital signature) are sent to the examinee clients and shown on the top of the computer screen. Using IP restriction, the examinees can be gathered within a specific area in the public lab, which make it possible for the examination supervisors to check the IDs on the screens with the persons seating in front of them. Figure 3 illustrates this process.

### 3.3 Examination Generation

Examinations are composed by questions which are stored in database and indexed by the question IDs. The question is represented by a 5-tuple:

$$\text{question} := \langle \text{ID}, \text{type}, \text{content index}, \text{difficulty}, \text{time} \rangle$$

The platform can create the exams semi-automatically according to the required parameters such as the average difficulty, the total time of the exam and so on. The process is illustrated in Figure 4

The examination can be represented by a set of the questions, title, course, difficulty and the total time:

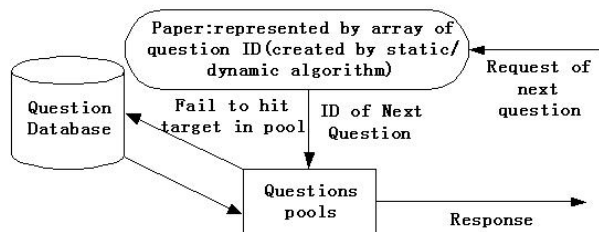


Figure 4: The Process of the Examination Generation

examination:=<set of the questions, title, course, difficulty, total time>

In general, there are two types of examinations:

- Static Examinations

The question set is generated before the test; it will not change during the course of the test. In this point of view, the question paper is represented by a static array of question ID. The order of questions in the test can be changed upon user's requirements; however, questions in paper can not be modified or replaced by other questions.

- Dynamic/Adaptive Examinations

The question set is generated during the test; it will change according the performance of the examinees following the exam-building rules provided by the examiners.

It is worth noting that the platform does not provide any specific algorithms for examination generations, but a universal interface for these algorithms. The platform could support both types of examinations as long as the examiners provide the generation rules/algorithms. There are several mature algorithms for this process [HLC99].

## 4 Conclusion

TH-IBEP was first used in Tsinghua University in July 1999, using TCP/IP as the fundamental protocol. So far more than 10,000 students have used the

platform taking examinations of language courses. The platform has been proven to be a robust, adaptive and general tool supporting various types of examinations because of its flexible architecture and reliable authentication strategy.

## References

- [HLC99] Hexiao Huang, Weidong Li, and Xiaohe Chen. An internet and network based test system (ints) without test paper and floppy disk. In *Proceeding of the International Conference On Distance Education*, pages 165–170, Apr. 1999.