CHAPTER 2
LITERATURE SURVEY

2.1 INTRODUCTION

The rapid development of computer and network technology makes profound changes to human beings in the fields of study, work and way of life. With the enrich and renew equipments in the teaching institutions and the training institutions, the establishment of Multi-media classrooms and campus network, the internet technology’s maturity and the popular of computer-aid education (Du Ploov 1992), the methods of examination which is used to check the quality of teaching and teaching effectiveness, assess the students learning and identify the skills have been changed greatly (Breithaupt et al 2005, Buchanan 1999).

2.2 PRIMITIVE STAGE OF ON LINE EXAMINATION

The first experiment was performed in 1997 when students sat a formal supervised examination in which the examination paper and the students’ answers were transmitted between the Open University and the remote examination sites using electronic means. The work on examinations and testing has focused on free-text entry style answers (Du Ploov 1992).

The second experiment, conducted early in 1999, enabled students to take a ‘mock exam’ accessed via a web page as part of their revision. The experiment was designed to test out the technical feasibility of offering an
unsupervised home examination. Students accessed the paper via a web site and submitted their answers in a similar way. The students keyed their answers into an ordinary word processor, the results of which were encrypted and returned via a secure web page by the invigilator at the end of the examination period (Breithaupt et al 2005, Carswell et al 1999).

2.3 ON LINE EXAMINATION

Ping Guo et al (2008) proposed that the Online examination system (OES) can be divided into two models; they are Browser-Server (B/S) model and Client-Server (C/S) model (Buchanan 1999, Liu et al 2004), the basic functions of them remained the same. An OES has a series of functions including intelligent auto-generating test sheet (Zhang and Zhan 2001), tracking and recording of the process of candidates’ answering, intelligent marking and the statistical analysis of students’ grades and so on. It can not only reduce the work of teachers, ensure the effectiveness of examination results and the principles of fairness and justice of the examination, but also reduce the work of organization of the examination and save the cost of the examination. The monitoring system sends the images in every examination room to the monitoring departments of the examination management centre (EMC), the invigilation teachers and leaders can know the situation at a remote place, which can prevent the candidate from abnormal behaviors, such as cheating, and the fairness and impartiality are ensured very well. In addition, all the images transmitted in to the monitoring department can be recorded and are the most important evidence for intendance after a test.

However, the OES architecture failed to provide solutions when the Examination server fails in an examination site and the computer in the examination halls are affected. Similarly it has not addressed the issue of failure of database server and the recovery measures to ensure reliable service.
OEES (Xingbao Li and Yunming Wu 2007) (the online examination and evaluation system) is based on B/S structure, in which the process of examination and evaluation has been logically classified into four irrelevant sections by functions: content-displaying layer, application-running layer, data-operating layer and database (Ling 2002). The two abutting sections communicate through a standard interface. The content-displaying layer is a user interface system, which contacts with users directly. The application running layer, the core of OEES, realizes communication between users and database by program, such as the program of making up paper, testing, keeping time, and analyzing results. The data-operating layer visits the database. It receives data requests from up-layer, sends SQL order to database, and then returns the results to the application layer.

The database layer is the base of whole system. All data will be stored in database. OEES was developed with JSP (Java Server Pages) and SQL Server database technology. The functions of OEES is composed of subsystem of student, subsystem of teacher and leader, and subsystem of administrator. OEES provides a testing platform on which the authors input test questions into item bank, organize questions, make up paper automatically, test, evaluate students and analyze papers.

Even though it provides an honor roll in the contest, from which everyone in the contest can know his score and place in all competitors (Yu and Wang 2002), it fails to address the security measures. In automatic mode, teachers should choose the questions type, the number of every type, the difficulty degree, and the difference degree according to examination outline of the subject (Jin and Wang 2002). Since the questions are picked out at random, it is hard to avoid the appearance of deflection.
As system can count and analyze the results of one paper automatically and rapidly, including the distribution, convergence and variation of scores (Wang and Xie 2002). It also can analyze the reliability and validity of one paper but fails to give suggestion to the teacher. Though the student-evaluating module analyze results for each course of the student, in terms of score ratio, score of objective questions, score of subjective questions, discrepancy with the average score, and used time (Zhang and Zhan 2001), it doesn’t address the relative scores.

Sophal Chao and Reddy (2008) designed an internet-based examination system which is flexible for teachers to set and control the student examinations. It has a feature to share information among departments, user groups and institutes, not like the other online examination systems on the market: A Web-Based Examination and Evaluation System for Computer Education (Yuan and Zhenming 2006), Mixed-method validation of pedagogical concepts for an intercultural online learning environment (Effie Lai-Chong Law 2007), Tablet PC in a collaborative learning environment (Jean and French 2007), and Online annotation- research and practices (Lan and Glover 2007). Though, it has unique feature of sharing information, it does not talk address the scalability issue.

Virkram Jamwal and Sridhar Iyer (2001a,b, 2003), Virkram Jamwal (2001) have implemented mobile agent based system for distance evaluation (MADE) of students distributed over large areas by using Voyager ORB framework. They found that this approach yields many advantages over other traditional approaches in terms of scalability, flexible structuring, dynamic extensibility, and independence from network disconnections. Other advantages gained were in the form of application layer multicasting, support for dynamic content and provision for both push and pull mode of information dissemination. However, their system still needs suitable techniques for
proper control and management of these different mobile agents. Better methods of handling autonomy and improving the overall system reliability need to be formulated and implemented. Besides, they lack the critical requirement, protection of agents (e.g. Answer Agent) from malicious tampering, when they move from closed to open environments. Though multiagent based teacher assistant (MATA) for universities, colleges and schools around the world assisting teachers in student evaluation, grading and enhance student teacher interactions in an intelligent automated way thus reduces burden on faculty members and provides services to the students around the clock. MATA can not only be view as a replacement of the traditional mediator, a human teacher assistance, which bridges between teacher and students but also an accomplishment of a system that could assist teachers in the process of evaluation. The system (MATA) has the problems in remote administration in case of the failure of main nodes which provided the serious set back in MATA and lacks of the proper control and management of the different mobile agents, overall system reliability and protection of agent.

Existing computer based evaluation mechanisms, usually do not scale well and also do not fully support features like: evaluation of subjective questions, delivery of dynamic content and off-line examinations. These features are extremely desirable for distance evaluation and there is a need for alternate ways of designing such applications. Mobile Agents are an effective paradigm for distributed application. Mobile Agents are autonomous software entities that can halt themselves, ship themselves to another agent enabled host on the network, and continue execution, deciding where to go and what to do along the way. They offer many advantages over traditional design methodologies like: reduction in network load, overcoming network latency and disconnected operations. (Moe Aye and Mie Thet Thwin 2008) aimed to model an agent-based system, able to replace the existing paper-based
examination system. This system aims to map closely to real world online examination scenarios and to fulfill the lacks of the existing systems.

The roles of the different agents are as follows:

- **Prepare Agent** - Carries the input data, such as user level, date and time, to the Question Assembler, and prepares question on the Question Assembler
- **Fetch Agent** - Collects comprehensive question from the Question Assembler
- **Courier Agent** - Carries only a single copy of the question and moves on to the next centre after supplying a copy of the question to the Distribution Server at an examination centre
- **Question Agent** - Carries the question to each student, presents the question to each student, record the answer, and carries the answer back to the Distribution Server of Exam Centre
- **Answer Agent** - Carries the answer of a student to the Evaluation Server. Gets the itinerary of the examiners from the Evaluation Server, visits the Evaluators to get itself evaluated, gets the result of the evaluation from the evaluators, and supplies the final result to Publish Server.

Though this paper presents multiple agents for different tasks to be accomplished, the Courier Agent carries only a single copy of the question.

Swe Zin Hlaing and Yangon (2009) designed a framework which is concerned with creating Web-based services for Virtual Learning Environment (VLE) related to Student Assessment using mobile agent technology. These agents protect their secured data by carrying their own
protection mechanisms and communicate with multiple agents using a single server. The authentication of mobile agents is controlled by using digital signature and a Public Key Infrastructure and has been implemented in Mobile Aglet platform.

The major problem of creating the virtual environment involves domain modeling and implementing the model using the most suitable technologies. Mobile agent systems have many advantages over traditional distributed computing environments: requires less network bandwidth; increase asynchrony among clients and servers; dynamically update server interfaces and introduce concurrency. These mobile agents protects themselves against host trying to temper maliciously with either the code or the data carried by incoming agents (Ametller et al 2004). In secure mobile agent application, two problems need to be addressed. a) The host platforms receiving and executing mobile agents must be protected against malicious code. b) The mobile agent should be protected from any intrusion and the resources hosted by a remote host should be protected from any unsuitable access by a mobile agent (Peng et al 2001). It is known as the malicious host problem. This problem is solved by two issues: confidentiality and integrity. Confidentiality means that information be protected against unauthorized access. It is now also a major concern for companies and private persons. Integrity ensures that a particular piece of information has not been modified at some point in time. Integrity is also an important issue for mobile agents. For example, the owner of an agent starts an agent with initialization data. It is very important that integrity of the itinerary not be attacked; otherwise, the agent could be sent to arbitrary hosts.

A mobile agent informs the server before it leaves an agency and after it has reached its new location. If the central server is responsible for tracking only an agent’s location, the sender requests the target agent’s
current location and current message send to this agency. The sender agent and its hosting agency can then buffer the message and try to locate the target agent later. Neither of that approach scales with the number of agents and the number of messages- it is a bottleneck for the entire agent system and a single point of failure. The extension of central sever approach is the home server approach. The home agency then not only forwards messages to the agent’s current location but also informs the sender agency about its current location. The home server approach scales better than having only a single tracking server and is a good choice in small or medium agent systems.

The home server approach helps to extend the trusted environment of an agent’s home base to other agent bases as well. As the agent moves from one host to another accumulating result, the results are protected for confidentiality and integrity in such a way the malicious host cannot read or modify or insert data without detection. Signing has been used to ensure that a host cannot dispute the information that it has previously entered into the data store of the agent. These techniques provide some measures for detecting tempering of agent code and data as it moves from one host to another. However, it fails to address to communicate to multi-agent framework.

Chen Yu, Zhang jian, Yi Bo described the solution to the authentication problem in online examination system for large-scale (Chen Yu et al 2009), using a novel principal component analysis neural network algorithm for fingerprint recognition. Based on the basic principles of feature selection and feature extraction for principal component analysis Construction of Symmetric subspace model and the convergence of Symmetric subspace algorithm was analyzed.

Yong Ou-Yang and Hong-Fang Luo (2009) explained an improved genetic algorithm and proposed a new method of test paper generating based on student’s learning situation. It generates personalized test paper
dynamically that satisfying every student according to student’s online self condition in distance education network and factors reflected during learning such as psychological status, comprehension and application level.

Composition of one set of test paper involves many factors, and each test question includes many attributes. Attributes associated with paper generating includes time, question type, chapter, knowledge point, difficulty coefficient, level and score these seven items. Time is what students needed to finish test question in normal. Question type is divided into multiple choice, judgment question and essay question. Chapter and knowledge point identify concrete content that examined by test question. Whether test question is easy or difficulty is decided by difficulty coefficient. Level is defined according to requirements such as concept, theoretical analysis and application. Score value of test question is marked by score. The seven attributes above can be got when one test question is extracted from item bank. A piece of test paper is composed of n test questions which extracted from item bank, and an attributive matrix of n*7 test questions can be got, of which each column represents one attribute, and each row one test question.

The test content and difficulty should be different according to different student, constraints that the attributes from the 4th column to the 6th column should meet, are established dynamically according to student knowledge learning model before running the algorithm of test paper generating. Modeling learning situation of each student, student knowledge learning model reflects students’ performance in intelligent educational environment during learning. The paper regards 6 evaluation values and 15 quantities as reference factors to evaluate student’s learning situation, the former includes memorization, comprehension, application, analysis, integration and assessment; the latter contains performance of the test, age, educational background, physiological conditions, learning environment,
mood, learning efficiency, etc. It receives estimation of degree that student masters in terms of concept, theory and application. Generating question problem is an optimal solving problem of multi target, and the optimal solving is not unique.

2.4 COLLABORATIVE ONLINE EXAMINATION

Jia Shen et al (2006) discussed the impact of collaborative online examination on learning and student satisfaction. They presented the results of a field experiment on online examinations facilitated by collaboration support systems. In particular, the paper examines collaborative learning and virtual teams through online examinations as an assessment procedure, compared to traditional examinations. Assessment is increasingly regarded as an important part of the learning process. Applying constructivism and collaborative-learning theories, the collaborative examination process features students’ active participation in various phases of the exam process through small group activities online. They had conducted A 1 × 3 field experiments evaluated the collaborative online exam compared with the traditional in-class exam, and the participatory exam, where students participated in the online exam processes without groups. Results indicated that collaborative examinations significantly enhance interactions and the sense of an online learning community and result in significantly higher levels of perceived learning.

As computer networks and virtual teams proliferate, learning and knowledge sharing in the online environment become increasingly important. Yet, while collaborative learning in virtual classrooms (Hiltz, 1994) and asynchronous learning networks (ALNs) have become widespread, traditional exams still dominate. Instructors control the exam process by designing questions and grading and administering exams; distance-learning students often have to travel to exam centres or take proctored exams. Students should
not only be evaluated but learn through assessment. With the total-quality movement and its adoption to education (Deming 1986), (Olson 1992), assessment has evolved from providing an accounting of students’ learning to being increasingly regarded as an important part of the learning process (Wright 2003).

Traditional instructor-controlled exam reflects the objectivist learning model (Leidner and Jarvenpaa 1995), which regards learning as the uncritical transfer of objective knowledge from instructor to students. New assessment approaches based on constructivism theory (Piaget 1970), propose that learners actually construct knowledge. For example, learner-centred assessment (Huba and Freed 1999) and classroom assessment (Angelo and Cross 1993) shift the attention from instructors and teaching to students and learning through assessment. Actively engaging students in the entire exam process as online collaborative groups increases perceived learning and the sense of community.

Collaborative learning is a learner-centred and team oriented approach that is based on constructivism and social learning theories (Vygotsky 1962) and assumes that learning emerges as learners interact with each other. Studies have shown the superiority of collaborative learning in both face-to-face settings and ALNs using group support systems (GSSs) (Alavi 1994, Hiltz 1988, Sloffier et al 1999) and in knowledge management in distributed teams (e.g., (Wenger 1998). Despite the collaborative-learning paradigm that dominates ALNs, only a few studies have been conducted to incorporate student active participation and collaboration into assessment processes online. With the use of GSSs, student participation and collaboration have been integrated into specific phases of the collaborative assessment, such as collaborative development of the grading scheme (Kwok and Ma 1999), question composition (Wilson 2004), collaborative question
answering (Shindler 2004), and peer and self-grading (Falchikov and Goldfinch 2000), Topping 1998, Sluijsmans et al 2003).

One study that features student active participation in various phases of the exam was conducted at an American university (Shen et al 2005, 2004, 2001). The online exam was adopted in a graduate-level course for five semesters, where students designed essay-type exam questions; answered questions designed by peers, and graded answers to the questions they authored. The exams were conducted over a 3–4-week period using asynchronous conferencing systems. Student surveys revealed overall favorable attitudes toward the online exam process, including learning effects and high student satisfaction. While initial studies revealed positive results through the students’ active participation in the online exam process, the students’ involvement in the exam was individual (termed “participatory exam” in this paper). To further incorporate constructivism and collaborative-learning theories, a “collaborative exam,” which features students’ participation in various phases of the exam process through small group activities online, was designed. Will small group online exam activities further enhance student interaction, learning, and satisfaction? The paper answered this question by presenting the research model, study design, and experiment results.

Although the paper (Jia Shen et al 2006) demonstrated that in higher order learning there is significant differences exist between the collaborative exam and the traditional exam regarding perceived learning, based on Bloom’s taxonomy, which measures learning from lower levels such as understanding the materials to higher levels such as solving problems and making generalizations, it is yet to be proved with subjective test.
2.5 SECURITY FOR ONLINE EXAMS

Jung and Yeom (2009) proposed an enhanced secure online exam management environment mediated by group cryptography using remote monitoring and control of ports and input. Since the security of online examinations remains a problem, the person writing the exam on a networked computer is monitored by a proctor at some predetermined location (Jordi et al 2006), (TOEFL Online). But, the requirement for an exam location goes against the accessibility, the major attraction of e-learning or distance learning. The requirement may also negate the cost savings generated by e-learning or pose obstacles for remote students. Simplification and automation of educational processes are other benefits of online education (Rowe 2004, McGough et al 2001), and online exams inherit these advantages. To remove the requirement for human intervention in secure online exam management so as to capitalize on the advantages of online processes, (Jung and Yeom 2009) proposed a solution to the issue of security and cheating for online exams. This solution uses an enhanced Security Control system in the Online Exam (SeCOnE) which is based on group cryptography with an e-monitoring scheme. The cryptography supports enhanced security control for the online exam process, as well as authentication and integrity. The e-monitoring provides a proctor function to remote examinees to prevent cheating, and thus removes the requirement of having to go to a fixed location.

The proposed system (Jung and Yeom 2009), administers an online exam at a fixed time with the same questions for all examinees, just like an off-line exam, but without restricting the physical location of the examinees. As the SeCOnE system enables many kinds of tests to be given online, it can provide teachers with better evaluation standards for students and may contribute to improving the quality of education.
Jordi et al (2006) proposed system was based on a secure exam protocol with an omnipotent central manager who controlled all the information for students, teachers, problem sheets, answer sheets, and grades. The weakness of this system was that the manager was assumed to be absolutely honest. Moreover, a restricted room was required for the exam, to prevent cheating. The security problems related to online exams includes unauthorized access to the problem sheets before the exams, but also modification of the questions, the answers, and the grades (Jordi et al. 2006). In addition, different cheating patterns exist (Ko and Cheng 2004), (The Blackboard Northern Illinois Univ. Online), including copying the answers of others, exchanging answers, searching the Internet for answers, using the data and software saved on the student’s local computer (Rogers 2006), (McCabe et al 2001), and discussing the exam by e-mail, phone, or instant messaging. Several methods of combating this include giving a different problem set to each student (McGough et al 2001, Ko and Cheng 2004), restricting the exam room (Rogers 2006, DePiero 2001), or limiting the number of answer submissions to one (Rogers 2006). Research has focused on methods to check student identities and to communicate securely between teachers and students (Jordi et al 2006, Shafarenko and Barsky 2000), rather than on countermeasures against cheating on online exams. Cheating on off-line exams is also a big problem. According the studies of (Rowe 2004), (Burgoon et al 2003), as the level of communication between teachers and students decreases, the tendency to cheat increases. This effect has a direct impact on online exams, when students may have little contact with their teachers.

Most modern online education uses Web-based commercial course management software (Goffe and Sosin 2005) such as WebCT (Rogers 2006), Blackboard (The Blackboard Northern Illinois Univ. Online), or software developed in-house. This software is not used widely for online exams, due to security vulnerabilities, and the system must rely on students’ honesty or their
having an honor code (Adams and Armstrong 1998). Previous Web-based approaches to online exams have highlighted easy accessibility and simplified exam management (McGough et al 2001, (Ko and Cheng 2004), (DePiero 2001), (Shafarenko and Barsky 2000). However, authentication through only a user name and password can be the weak point in the security of online exams. The very environment in which students can use a Web browser and the Internet enables them to search the Internet and to communicate with others for help during the exam. Ko and Cheng, proposed a Webcam to prevent cheating by randomly transmitting pictures of students during online exams (Ko and Cheng 2004). However, several soundless pictures of a student do not show what that student is doing or why he or she is doing it, or even if cheating is taking place through Web searching, the use of saved data, or chatting. Considerable discussion had took place on group protocols and group-mediated communications to ensure secure communications among group members (Agarwal et al 2001), (Berket et al 2001). So, (Jung and Yeom 2009) have included the consideration of secure group composition, secure intergroup communication using a public key, and secure intragroup communication using the symmetric key through the Diffie-Hellman key exchange (Bresson et al 2007). (Jung and Yeom 2009) Adopts two groups for secure communication between distributed entities in the online exam system. The intergroup communication is protected through public key infrastructure (PKI), while intragroup communication uses several symmetric Diffie-Hellman keys.

All entities in the SeCOnE system perform their roles as members of either group or receives the problems and the right answers from , and then distributes the problems and collects the answer sheets from . A proctor monitors the examinees through using the monitor data in. Through, an examinee belonging to and managed by, can take the online exam. The group agents and create a set of public and private keys for each group. They distribute this set of keys to their group members at each exam, and exchange
the public keys with each other. The public key of each group is used for secure intergroup communications.

For secure communications among group members, they use the symmetric keys created by the Diffie-Hellman key exchange (Diffie et al 1976).

The examinees’ computers should be equipped with Webcams and microphones. High-quality Webcams are readily available now and are constantly improving. The SeCOnE system software is divided into two parts depending on the role, that is, whether it is on the client side, or server side.

Cheating is any behavior that places the fairness of the exam in doubt. The types of cheating techniques covered although not all cheating techniques may be covered, the scheme proposed is a way to avoid simply relying on the examinee’s sense of honor not to cheat. The SeCOnE system adopts five methods to prevent and detect cheating. First, the identities of entities in the system are verified by a Webcam, and the reference photos taken during the verification process are saved for authentication during the exam. Second, the monitor data for the examinees are recorded and saved during exam. With continuous recording of video and audio during the exam rather than isolated images, a proctor can better understand the examinee’s situation and reduce the chance of false-positives or negatives in the determination of cheating, even after the exam. Third, through the screen shots saved in parallel with videos of an examinee, a proctor can better determine what the examinee is actually doing with his or her computer. Fourth, all communications by the examinees, except for those required for the online exam, are disabled through port control.

All ports except those required for the online exam are disabled and the ports used can be chosen randomly for each examinee; the ports to be used have only to be sent to the exam administrative group with the IP of the exam
client. Therefore, cheating through a fixed port can be rare. Fifth, all other programs except the online exam client are deactivated by controlling the inputs of the examinees. By cutting off electronic communications and disabling other computer programs or inputs on the examinees’ computers, the examinees can be prohibited from cheating using their local computer or the Internet. The main drawbacks in the system is, generation or more than one question set, as there is no restriction on the time of taking examination.

2.6 SUMMARY

The proposed e-examination model is designed based on the earlier preliminary study by Jordi et al (2006), who developed a secure examination protocol with an omnipotent Central Manager, which controls all the information for students, teachers, questions, marks. The limitation of this system is that the manager is assumed to be absolutely honest. Moreover, a restricted room is required for the examination, to prevent cheating. In the proposed model, if the omnipotent Central Manager is attacked / failed, the system is revived from the replication server attached to the Central Control Centre. Hence the present model is enhancing the reliability of the system.

Mc Gough (2001) proposed a web-based testing system with dynamic question generation wherein the questions need not to be of same standard. But for the admission to colleges, the question paper should be of same standard as the applicants need to be evaluated based on a uniform standard. A notion of degree of difficulty has been introduced in each question in the question bank. This model is explained in chapter 4.

Ping Guo et al (2008) proposed on line examination system. It has intelligent auto-generating test sheet, tracking and recording of the process of candidate’s answering. The system authorizes different authorities to different users. The system has data security of transmission, data security of usage.
How ever this system failed to provide solution when the examination server fails in an examination site and the computers in examination halls are affected. The present model is provided with a mechanism to handle the failure of a terminal.

Jung and Yeom (2009) proposed a system which uses an enhanced security control system in the online examination (SeCONE). This is based on group cryptography with an e-monitoring system. It administers an online examination at a fixed time with same questions for all examinees, just like an off-line examination, but without restricting the physical location of the examinees.

Though most of the literature survey is on e-examination, the current research considers the concept of e-examination for better coordination of earlier processes such as registration, hall ticketing, allocation of examination dates and the later process of conducting counseling. The proposed model for earlier processes is explained in chapter 3 and for later process is explained in chapter 5. Comparison based on cost involved in different processes are analysed in chapter 6.