Secure Online Exams on Thin Client

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Abstract—**Nowadays, the online exam is become popular because the examination often have multiple-choice questions that can be quickly automated evaluation and graded by automated test scoring machines known as online exams. This paper proposed the secure online exams on thin client. The client in this system can be used older computer to reduced total cost of ownership. The proposed system used the Ubuntu operating system; the LTSP and the LXDE desktop manager to provide the thin client infrastructure in a dedicated exam room. The quiz activity was managed by Moodle that is a popular course management system.**

Keywords— LTSP; Moodle; online exam; thin client

I. INTRODUCTION

Online exam is one of the most popular parts of online education. The benefit of online exams is quickly graded by automated test scoring machines of standardized questions like multiple-choice. There are several online exam used in schools or universities area have been developed. It can be grouped into two types as fat client and thin client.

A fat client (also called thick client) is a computer (client) in client–server architecture or networks that typically provides rich functionality independent of the central server. A fat client still requires at least periodic connection to a network or central server, but is often characterized by the ability to perform many functions without that connection. In contrast, a thin client is a computer which depends heavily on its server to fulfill its computational roles. A thin client generally does as little processing as possible and relies on accessing the server each time input data needs to be processed or validated. Thin clients occur as components of a broader computer infrastructure, where many clients share their computations with the same server. As such, thin client infrastructures can be viewed as providing some computing service via several user interfaces. This is desirable in contexts where individual fat clients have much more functionality or power than the infrastructure requires.

Thin-client computing is also a way of easily maintaining computational services at a reduced total cost of ownership [1]. The most common type of modern thin client is a low-end computer terminal which only provides a graphical user interface to the end user. The proposed secure online exams on thin client are also fall in this type. Users prohibit accessing any client storage even internal storage (hard-disk) or external storage (flash-drive) to prevent the cheat.

II. RELATED WORK

The security risk of online exam can be classifies into seven types of risks [2] as testing mismanagement, impersonator, PC misuse, forbidden stuff, accomplice, test leakage and "Electronic Warfare". He introduces the resultant Dependable observable Distributed online Testing (DoDoT) reference model, and examines its coverage by three commercial systems. However, these systems are not yet in use in most distributed education frameworks and do not have yet full DoDoT coverage. The vision of the DoDoT reference model is the continued pursuit and adaptation of new, innovative technologies and methods to make dependable distributed testing increasingly more computerized, reliable, affordable and prevalent.

In 2012, Frankl et al. [3] describes the "Secure Exam Environment" (SEE) to support exams based on Moodle to be held on student laptops without access to local files or the internet. Additional programs like Excel or Java applications can be installed and used during the exams. Their clients boot to KNOPPIX operating system [4] on the laptop. It is booted via flash drive or DVD. The system denies access to local files and programs was shown in Fig. 1.
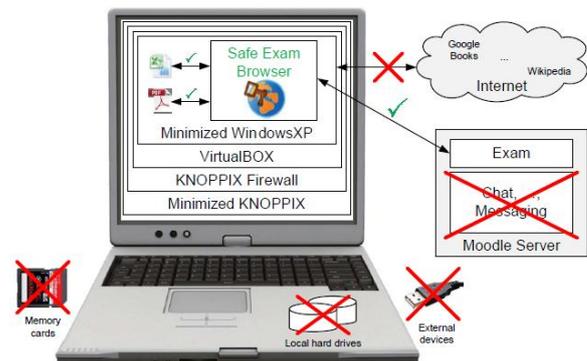

Fig. 1. Secure Exam Environment.

This system is suitable for the newer computer (client), over 95% of laptops built after 2008 can be used as clients in this system properly. But this system is not suitable for the older computer (client) that has limited RAM size and CPU power because this system has to run one operating system (Windows XP) on virtual machine over the other operating system (KNOPPIIX).

III. EXPERIMENTAL DESIGN

The propose Secure Exams on Thin Client was developed using entirely open source software that are available for free use such as Ubuntu operating system [5], LTSP Linux terminal server [6], LXDE desktop manager [7] and Moodle [8].

Firstly, the Ubuntu operating system is fast, free and incredibly easy to use. This system empowers millions of desktop PCs, laptops and servers around the world including thousands of free apps.

Secondly, the LTSP adds thin client support to Linux servers. LTSP is a flexible, cost effective solution that is empowering schools, businesses, and organizations all over the world to easily install and deploy thin clients. New thin clients and legacy PCs alike can be used to browse the web, send e-mail, create documents, and run other desktop applications. LTSP not only improves Total Cost of Ownership (TCO), but more importantly, provides increased value over traditional computing solutions.

Thirdly, the Lightweight X11 Desktop Environment (LXDE) is an extremely fast-performing and energy-saving desktop environment. LXDE uses less CPU and less RAM than other environments. It is especially designed for cloud computers with low hardware specifications, such as netbooks, mobile devices or older computers. LXDE provides a fast desktop experience; connecting easily with applications in the cloud.

Lastly, Moodle is popular free software E-Learning platform (known as a Course Management System (CMS) and also the popular system for providing E-Learning on-line resource. It is a software package for producing internet-based courses and web sites and is designed to help educators create online courses for student interaction. Moodle is modular in construction, the quiz activity module allows the teacher to design and build quizzes consisting of a large variety of question types, including multiple choices, true-false and short answer questions. These questions are kept in the question bank and can be re-used in different quizzes.

To implemented the (Linux terminal) server. The server has to have at least 2 network interface cards. It connects to the internet on one network adaptor and connects the other available network adaptor to a network switch where thin clients will connect (please note that the LTSP server has its own DHCP server, therefore the router with its own DHCP server should not be use). The server used Ubuntu 12.04 Long Term Support (LTS) as an operating system. The '*ltsp-server-standalone*' package was installed to make us server as a Linux terminal server. The proposed server based computing was shown in Fig. 2.

At this point, the thin clients can be boot via the network by settings BIOS to boot from LAN. The thin client boot screen and desktop screen were shown in Fig. 3 and Fig. 4 respectively.
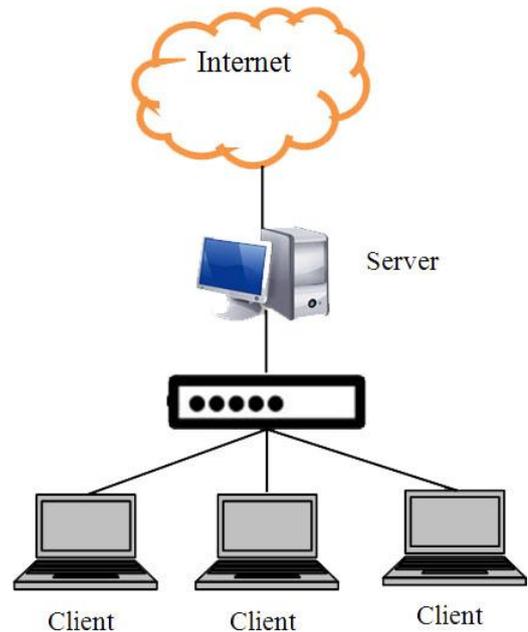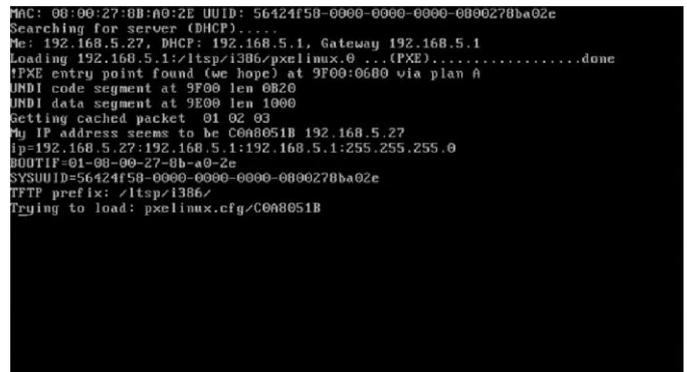

Fig. 2.   The server based computing.

Fig. 3.   The thin clients boot via the network.

Fig. 4.   The thin client desktop screen.

User management is a critical part of maintaining a secure system. Ineffective user and privilege management often lead many systems into being compromised. Therefore, in this experiment we force each thin client to log-in automatically with difference user accounts to prevent examinees access to other examinees files. To prevent the student opportunity to cheat, each user account set to none special privileges as shown in Fig. 5.
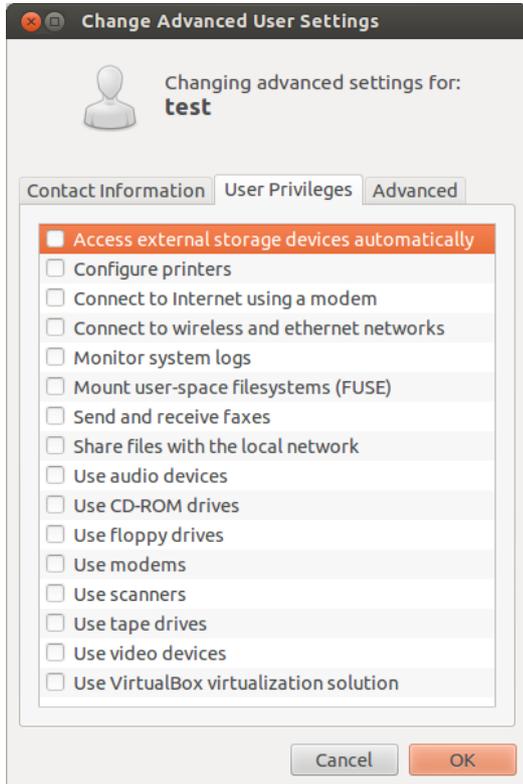

Fig. 5.   Student's user privileges.

The default installation of LTSP on Ubuntu allows user to access external USB storage devices event user does not have the privileges. To solve this problem we have to setting 'LOCALDEV' to 'False' in 'lts.conf' configuration file.

To enhance the performance of the system, the light weight desktop manager namely LXDE was selected. We force the entire thin clients boot to LXDE desktop manager by setting 'LDM_SESSION' to '/usr/bin/startlxde' in 'lts.conf' configuration file.

After manage the thin client infrastructure already. Next we have to setup some security on the Moodle. For each quiz that has been created we setup 'Browser security' in the section 'Extra restrictions on attempts' to 'Full screen pop-up with some JavaScript security' as show in Fig. 6. The quiz will appear in a full screen popup window that covers all the other windows and has no navigation controls as show in Fig. 7. Students are prevented, as far as is possible, from using facilities like copy and paste.
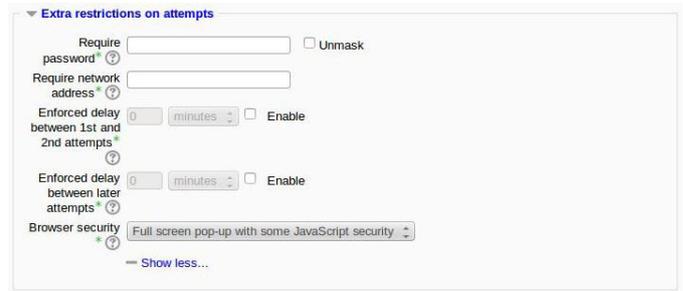

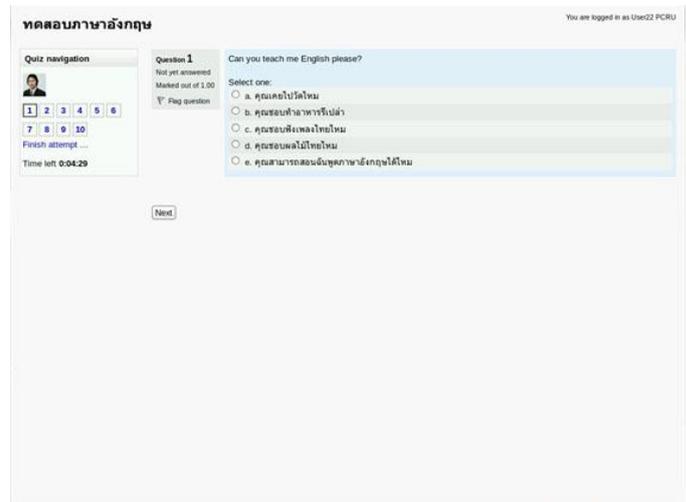Fig. 6.   Setup security control for each quiz in Moodle.

Fig. 7.   The quiz appears in a full screen popup window.

IV.   CONCLUSION

This paper proposed the secure online exams on thin client using entirely open source software. This system created the new online exams system with the older computer to be using again as a thin client. The benefit of the proposed system is to reduce total cost of ownership and easy to maintain the system.

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