SECURE DEMATERIALIZATION OF ASSESSMENTS IN DIGITAL UNIVERSITIES THROUGH MOODLE, WEBRTC AND SAFE EXAM BROWSER (SEB)

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ABSTRACT

This paper deals with a solution allowing digital universities to extend the functionalities of their distance learning platform to offer a secure solution for the dematerialization of assessments. Currently we are witnessing the rise of digital universities, this is the case in Africa, particularly in Senegal. We are witnessing strong growth in the number of students, in a context of extension and diversification of training offers. This is the case of the Virtual University of Senegal (UVS), the number of students has increased from 2,000 students in 2013, the year of its creation, to 50,000 in 2021. It offers 13 licenses and 30 courses of training.

With these large numbers, the organization of assessments in these universities becomes more and more tedious. Taking the example of the UVS with 50,000 students and 30 training courses, we will have to deploy millions of exams copies due to one copy per candidate. These universities have digital campuses (connected campuses) or Open Digital Spaces (ENO) which make it possible to organize face-to-face evaluations on the table. This organization has several disadvantages, on the one hand, the management of the proofs and the correction of the copies require the mobilization of human and financial resources; on the other hand, the risks of errors, reports and authenticity of the notes.

In this article, we propose a secure system for managing online assessments in digital universities based on LMS Moodle, SEB and remote monitoring with the JITSI video conferencing system.

The solution will allow universities to optimize human and financial resources and make assessment results more reliable.

KEYWORDS

E-learning, Moodle, Online Assessment, Exam, WebRTC, Safe Exam Browser

1. INTRODUCTION

Distance learning is becoming more and more essential in higher education institution. This period of covid-19 only confirms the need to put in place support solutions for higher education establishments for the dematerialization of their teaching and assessments. Providing a dedicated exam room with multiple computers is a possible but very expensive solution. However, taking exams on student laptops increases the number of simultaneous exams but also the possibility of cheating. The system we are proposing will also consider learners who, for one reason or another, cannot take the face-to-face assessment.

Several factors must be brought together to set up a dematerialized evaluation system. Security being essential, it must be considered in order to have a complete, robust system that inspires confidence in the various players.

For the implementation of this secure evaluation system in digital universities, several tools will be used, in particular a Learning Management System (LMS) for the evaluation of learners, a videoconferencing system for monitoring candidates evaluated remotely and a system for locking learners' computers and work tools throughout the duration of the tests.

This paper will be organized as follows: after the state of the art, we will make a solution proposal in which we will do the analysis and design of the solution. After that, we will make a proposal for a sizing model and end with a conclusion and perspectives.

2. STATE OF THE ART

With distance learning widespread in most higher education institutions, the question of the dematerialization of assessments is becoming more and more recurrent.

It is in this context that several authors work in this field. Among them, researchers AY Elmaghrabi and SM Eljack, in their article entitled "Enhancement of Moodle learning Management System Regarding Quizzes Security and Stability Problems", aim to improve the security of the Moodle system environment when running online exams, considering the most common problems faced by online exams. This has been addressed by improving the security performance of the Moodle Quiz tool, which is one of the most important tools in the learning management system in general and the Moodle system as well. In this article, they have included two aspects of improvement: the first aspect is to solve the problem of the loss of responses during a sudden short disconnection from the network due to a server crash or for any other reason, the second aspect is to increase the level of confidentiality of the e-Quiz by preventing access to the Quiz from several computers or browsers at the same time.

Researchers A. Natawiguna and MMI Liem, after conducting preliminary research on online exam cheating, its detection and prevention, presented virtualization methods to secure online exams against cheating attempts in a desktop client. real-time exam on their article called "Virtualization Methods for Securing Online Exam". They analyzed and compared two virtualization methods, namely hardware-level virtualization and operating system-level virtualization. Based on their experiences, hardware-level virtualization is the optimal method. The result of this research is a set of tools that can be used to improve existing proctoring methods used to secure the online exam. Ria Mae H. Borromeo, in her article titled "Online exam for distance educators using moodle" shows that online exams can be administered using existing systems, which can automate the exam scoring process depending on the type of exam question. The Open University of the Philippines (UPOU) uses Moodle as its primary Learning Management System (LMS) platform. However, not all UPOU online exams are administered through Moodle. Their study aims to determine the characteristics of an online examination system desired by university teachers. To achieve this, a survey and technology demonstration of the Moodle Quiz module has been developed. The survey was in the form of an online questionnaire in which the questions demonstrated the types of questions available in the Quiz module and asked teachers what features they would like to see implemented in an online exam system.

In addition to this research, other tools are currently used in universities for online assessment, such as Google Classroom which is an educational platform that offers teachers and learners a database of exchange with the objectives of coordinating homework, increasing collaboration and optimizing communication so that the teacher can manage his lessons, create content, give homework, grade work and send feedback to students. Eval&GO and Typeform are also proprietary online assessment design platforms that require an internet connection for use; Canvas is an open source platform that provides the ability to implement assignments and surveys to assess learners' understanding of the course. It makes it possible to create corrections by peers, group work; Track learner engagement, discussions, and results.

These solutions have contributed to the resolution of the problem related to online exams. However, they are not complete. It is in this perspective that we propose in this article, a contribution for a secure dematerialization of evaluations in digital universities through Moodle, WebRTC and SEB.

3. PROPOSITION OF A SOLUTION

3.1 Analysis

With the limited means of some African digital universities, the use of open source tools is essential, especially since several communities are available to provide support if needed. Existing solutions, as described in the state of the art, often do not offer the possibility of managing the entire chain from secure evaluation to automatic correction.

Most of the solutions used in digital universities are based on the LMS Moodle which is the most widely used open source training platform in the academic world. It becomes very useful in the organization of exams with the integration of SEB by default since its version 3.9. Moodle offers several assessment activities including quizzes and assignments. The Quiz activity module allows you to design and create quizzes consisting of a wide variety of questions, including multiple-choice, true-false, short-answer, and image drag-and-drop question types. of text. These questions are kept in the question bank and can be reused in different questionnaires. The Assignment activity allows learners to submit assignments by uploading one or more files. The question bank, when it is open to an entire teaching team, can be cumbersome to manage.

Safe Exam Browser (SEB), which is a secure and open-source exam browser, allows you to restrict candidates' access to external websites, system functions or other applications while they take an online assessment. This program makes online assessments more secure by transforming the candidate's work tool into a secure workstation.

Remote monitoring remains a weak point in the use of these tools. These solutions do not offer online monitoring during the course of assessments. The tests take place with the presence of supervisors in the examination rooms as is the case in traditional universities. The integration of an effective online monitoring solution remains very important.

3.2 Design

The design of the solution is based on the LMS Moodle, the Safe Exam Browser and the integration of an online monitoring tool based on the WebRTC.

Based on the existence of several proprietary or open source solutions, the choice to integrate a videoconferencing tool remains very important. Thus, the solution we propose is based on the coupling of 3 tools which are the LMS Moodle, SEB and Jitsi.

This solution makes it possible to take secure face-to-face exams in an exam center with thin clients or computers and remote monitoring. It also offers the possibility of monitoring candidates who take the tests from home.
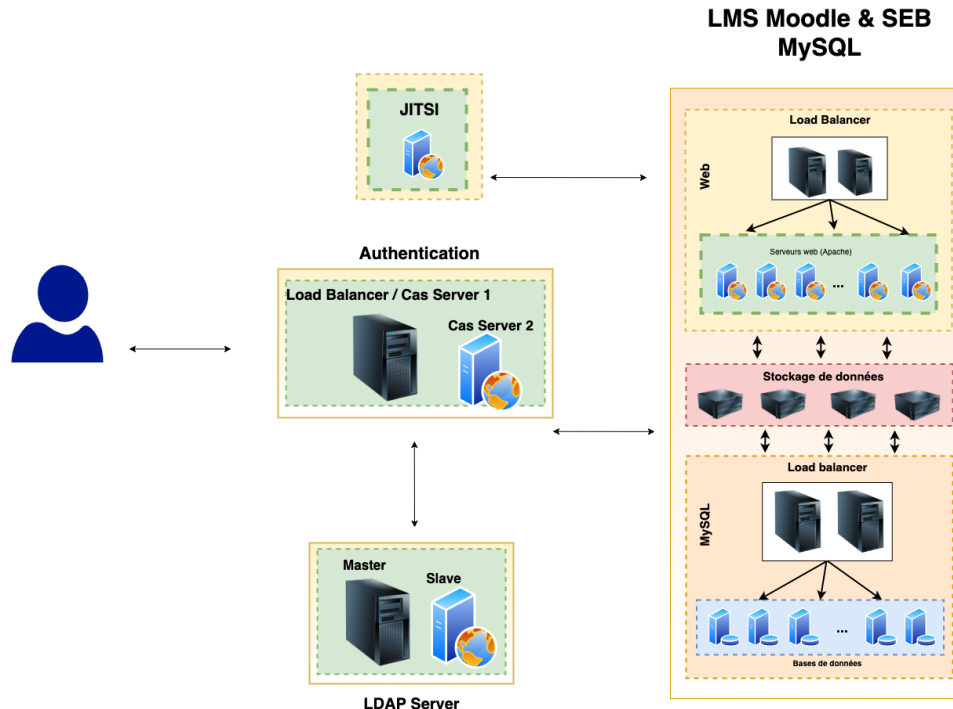

Figure 1. Technical Architecture of the assessment system

For better security management, we offer a centralized authentication system based on CAS as well as the LDAP directory for user management.

The sequence diagram below illustrates the operation of the solution with the interactions between the learner and the system.
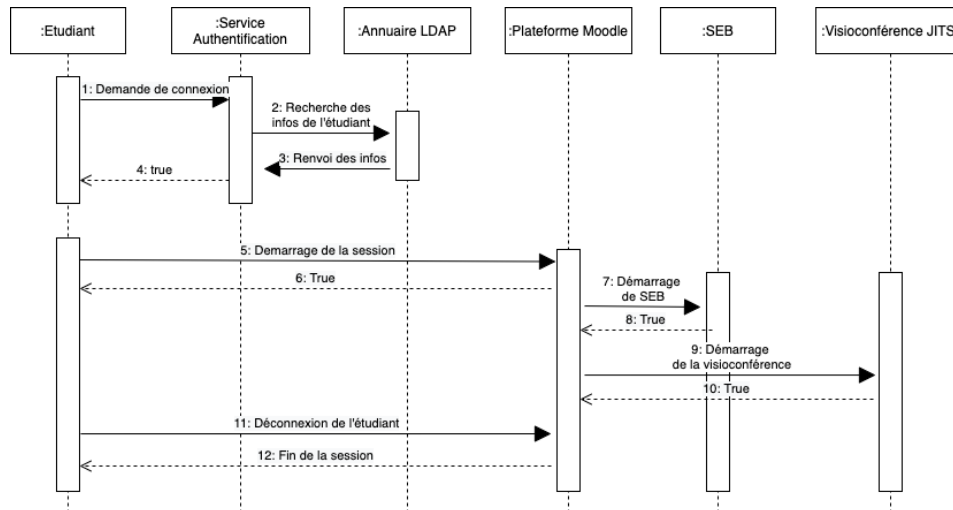

Figure 2. Sequence diagram illustrating the interaction between a student and the assessment system

3.3 Proposal of a Sizing Model

The LMS can be configured to provide very good performance, whether for small uses, or for use with several thousand users. The factors involved in runtime performance are web server, database server and video conferencing server.

The maximum number of concurrent database users needed for testing type activities is the number of users using Moodle at the same time. Generally, the amount of memory (RAM) installed is the determining factor but higher processor speed will also help to reduce page load times. Based on our architecture, the following rule applies:
- The maximum number of concurrent users = RAM (GB) * 50 => 32 * 50 = 1600.
- The maximum number of users in consultation = 1600 * 5 = 8000.

For our case, below are the characteristics of the servers used for the simultaneous management of 1500 candidates with good system performance:

webserver:
- Storage: 200 GB SSD
- Processor: 8GHz Dual Core
- RAM: 32 GB

MySQL Server:
- Storage: 200 GB SSD
- Processor: 8 GHz Dual Core
- RAM: 32 GB

WebRTC (JITSI) Server:
- Storage: 200 GB SSD
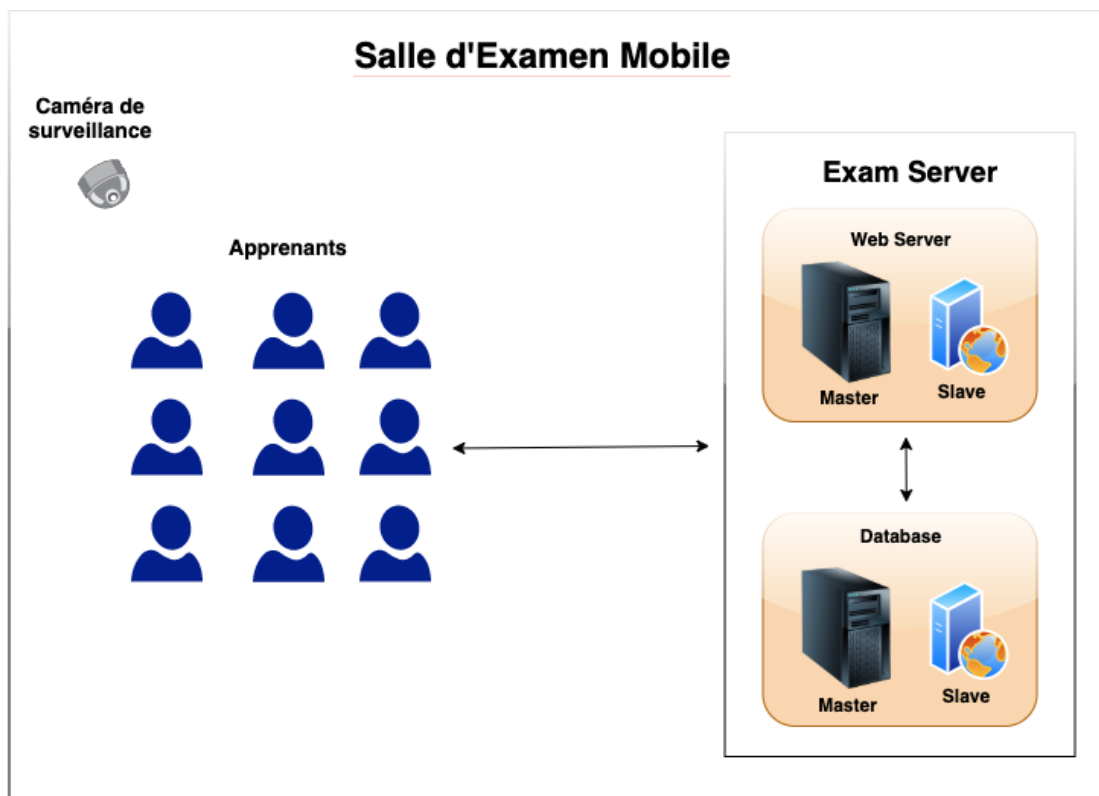- Processor: 8 GHz Dual Core
- RAM: 32 GB

Figure 3. Diagram of the solution

3.4 Securing the System

Cheating of students during exams is a phenomenon in the world, regardless of the level of development of the country. With the expansion of e-learning, exam proctoring becomes more difficult to control. Regarding the security of this system, several aspects will be considered; both on the network and system part. Among these security measures we have:

- the creation of a secure local network accessible only by the tools used for the evaluation;
- the separation of the web server and the LMS database server; this will increase system performance;
- the installation of a surveillance camera to film the learners during the assessment on the table;
- the implementation of a videoconferencing system for the remote monitoring of learners who are unable to move to the examination center;

3.5 Results Analysis

The implementation of this system allowed us to simultaneously evaluate 1119 learners during face-to-face exams out of 1256 enrolled in the course. What makes a participation rate of more than 90%.

Here are some excerpts from the platform's statistics:

Participants

Aucun filtre appliqué

Inscrire des utilisateurs

Chercher une expression ou sélectionner un filtre ▼

Nombre de participants : 1256

Prénom | Tout | A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Nom | Tout | A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

1 2 3 4 5 6 7 8 9 10 ... 63 »

Figure 4. Number of participants

Tentatives autorisées : 1

Ce test a été fermé le lundi 22 février 2021, 10:30

Temps disponible : 1 heure 30 min

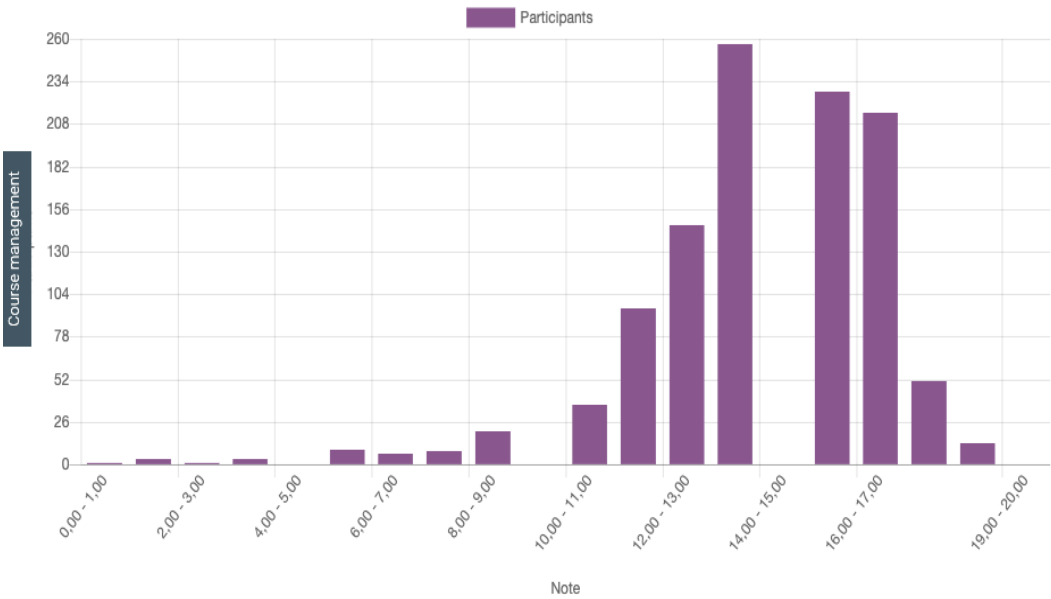Tentatives : 1119

Figure 5. Test setup

Figure 6. Statistics on grades obtained

4. CONCLUSION

In this article, we have proposed a solution for the secure dematerialization of assessments in digital universities through Moodle, WebRTC and SEB. The UVS with its growing numbers of students benefits from the advantages of this solution which makes it possible to carry out secure online assessments without the need for a lot of resources.

This work provided a solution for the dematerialization of assessments but highlighted another problem related to the automated correction of paper proofs after the assessment as well as automatic monitoring through artificial intelligence tools.

By way of perspective, with the plethora of learners in universities, the implementation of secure solutions for evaluation and automatic correction of proofs are essential. Automatic monitoring solutions with Artificial Intelligence (AI) tools would be a very good solution for monitoring assessments for institutions that have large numbers of learners.

We intend to continue the work to consider the issue related to automatic monitoring with AI-based tools.

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