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The Need for Secure Computer-based Assessment-Software

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Abstract and objective

Most of the computer-based assessment software available is web-based. While there are many advantages, for instance the possibility to use the same software for learning and assessment, there are legal and technical risks with this approach such as a network failure or the missing proof for the correctness of the collected data. Therefore a new software was developed at the Heidelberg University Hospital focusing on fault-tolerance and certainty of law. It uses a client-server architecture for real-time result display but through using different layers of logging a failure of the server will neither end the test nor any data will be lost. The system has been used for testing students of medicine at the Heidelberg University Hospital since the end of 2004.

Keywords:

assessment, medical education, security

Introduction

In Germany computer-based tests of students of medicine are rare. The main problems are the missing amount of computers for the assessment and the certainty of law.

Accordingly, most of the exams are paper-based although the need for case-based testing and the possibility to use multimedia, the key feature approach [1] or advanced question types such as 'long menu' [2] or 'hotspot' is attractive for medical education.

Most of the computer based assessments have been carried out with browser-based assessment software such as WebCT [3], .LRN [4] or Ilias [5]. These are web-based learning management systems used in the student's everyday work. Despite advantages like familiarity and the absence of client-side software installation, this approach has many problems when using that software for official examinations.

One problem is that every data is collected at the server. If the connection between the client (browser) and the server breaks, data will be lost. Software bugs in the software, a server-side hardware failure or a corrupted database will end the examination and can cause a loss of data.

The second main problem is the missing certainty of law of the test. As all data is just collected digitally at the server, a bug in collecting the student's data or incorrect data storage cannot be verified afterwards. Some systems demand a student signature on a hardcopy afterwards but this will raise the time need and could lead to discussions between the examiner and the student.

Implementation of a secure assessment software

On top of the CAMPUS [6] e-learning shell, which offers a simulative and a card-based player for students of medicine, a separate software module was created using the same authoring system.

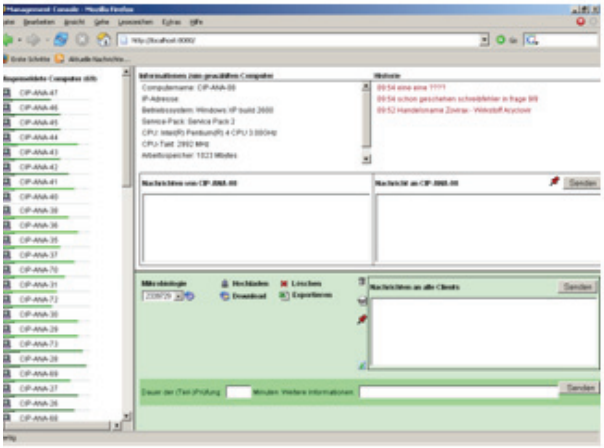

Figure 1 - The Management Console

The software consists of a PostgreSQL database, a server application, called "Management Console" (see Figure 1) and a client software (see Figure 2), all written in the Java programming language for best portability.

The Management Console is used by the examiner through a web-based interface. It controls the spreading of the test data and supervises the attached clients so that problems with them can be detected just in time. Additionally, a bidirectional messaging system can be used.

The client software acts as a normal desktop application (except it can be distributed and updated automatically via a webbrowser using the Java Webstart technology [7]). As it isn't bounded to the browser restrictions, the client can

be protected through an exclusive ‘kiosk-mode’ to prevent manipulation or fraud attempts using e.g. a chat.

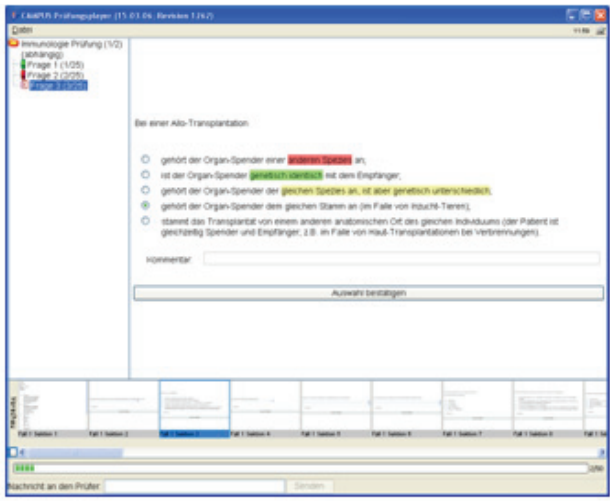

Figure 2 - The client software

Log files are created at every layer so that the test can be reconstructed even in case of a complete and permanent server failure. With this technology a breakdown of the server or a network failure is transparent to the client software – the test can be continued and the data can be synchronized later.

To ensure certainty of law, a screenshot, showing the unprocessed raw data of the examination, is taken each time a student commits an answer. Those screenshots are combined into a video which can be used to validate the result of the test afterwards.

To increase the confidence of the students in the results the video can be sent to a student’s e-mail address after the test. This video is protected by a student’s and an examiner’s password so that both sides can prove its authenticity.

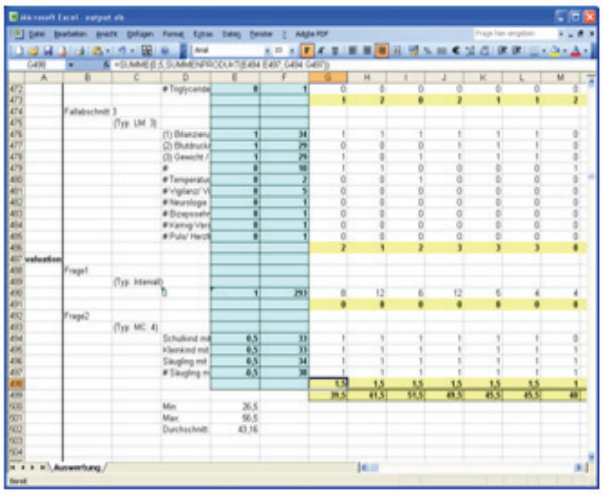

Figure 3 - Test results with adaptive formulas

The test result can be made available as HTML pages and a Microsoft Excel sheet with adaptive formulas (see Figure 3) where the examiner can modify the rating and sees the altered overall result just in time.

Results

The software has been used at the *Heidelberg University Hospital* successfully since 2004 with hundreds of students (up to 120 students at the same time). Although problems had occurred (for instance database problems), the videos and log files helped to reconstruct the corrupted or missing data completely.

The software has successfully addressed two of the main problems of computer-based assessment:

1. Prevention of having to abort an exam because of a network or server failure
2. Certainty of law for computer-based assessment by using unprocessed data shown as a video

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