The development and testing of a video system for online authentication of assessment

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Abstract Having an online assessment system that is secure, effective and efficient is a major problem for distance learning providers. At the University of Hertfordshire in the UK, the Criminal Justice Team (within the Social, Community and Health Studies) and the Department of Computer Science are two departments that deliver significant e-learning programmes. This paper describes the design development and evaluation of a secure system for verification of candidates' identities for use in online objective assessment, using video and chat. The findings of two studies are reported in the paper, a pilot study with expert evaluators and a study with a group of undergraduates. We were able to show that the method is acceptable to candidates and imposed little additional cognitive burden. We also measured the efficiency of the system developed and identify problems and limitations with the approach.

Introduction

The increased use of online learning systems in education today has in most cases been a positive influence on the learning experience, for learners and teachers alike. The University of Hertfordshire's Managed Learning Environment (MLE), StudyNet has been used within our university in a blended framework for learners both on and off campus since 2001. In 2003/4, 80% of staff and students were using StudyNet regularly with 3.62 million logins. In 2004/5, this figure had grown to over 95% of staff and students (4.85 million logins) including 51% of logins from locations off-campus. The use of technology in the assessment process is a logical progression following from the rapid advance of learning technologies.

Well-designed assessment is linked with major gains in student attainment and reinforces good curriculum practice (Ridgway, McCusker, & Pead 2006). This is particularly important for distance learning courses as there are very few built-in interactions between instructors and students. It is interesting to note that in 2006, for the first time, online assessment and on-demand testing were used in some subject areas by the Scottish Qualifications Authority. Assessment was carried out in school centres, with learners having to attend. Within the UK, some 5,000 on-screen tests are now being taken each week. (Scottish Qualifications Authority (SQA) 2005) Issues related specifically to

the requirements for online assessment, including security, have been given by Roan (2003).

The Department of Computer Science has several hundred remote online learners in locations as far as Trinidad, India and China as well as in the United Kingdom. This number is increasing year by year and is likely to do so in the future. Providing reliable, valid and fair assessment for these learners is difficult and expensive. It is essential that all concerned in the process are confident in the validity of our assessment processes as they are related to the perception of the quality of our qualifications. For this reason, remote learners are required to attend examinations and tests at the University in the United Kingdom or at assessment centres in other countries, in order that tests are properly supervised.

The research presented in this paper is the result of collaboration between two departments seeking a reliable and efficient way of providing an online assessment system capable of validating the identity of students remotely.

In the first stage of our research, the use of fingerprint recognition was tested. Findings from these studies suggested that although this system proved to be useful and reliable, they were difficult to implement and manage remotely at some locations. Tests with the Microsoft fingerprint reader showed that it was relatively simple to install which is important for remote learners. Registration of fingerprints was through a wizard. The finger print registration wizard allows you to register fingerprints by selecting the preferred hand and finger and then following the prompts to scan. Each finger must be successfully scanned four times and you can register up to 10 fingers. You can register other fingers at any time by using a registered finger to access the registration wizard.

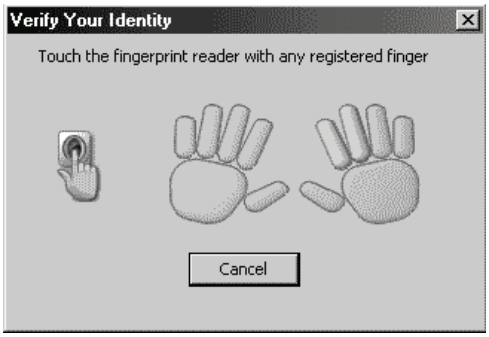

Figure 1 Fingerprint recognition system.

Creating a fingerprint login is simply a matter of going to the desired login page and scanning any registered finger. You then have the option to associate a username and password with the login page. Once complete, any registered finger will be able to use the login.

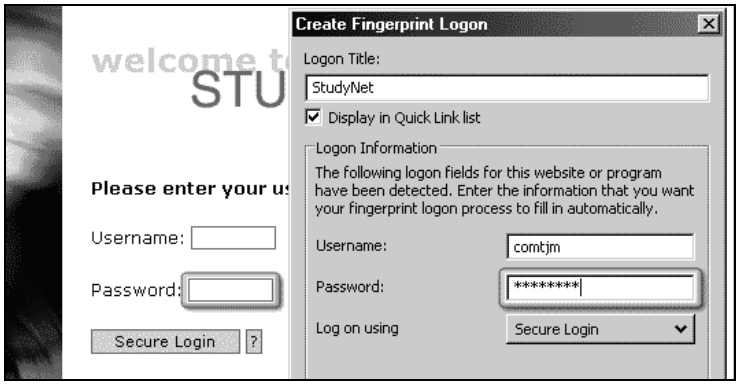

Figure 2 Fingerprint logon screen

Any registered finger (user) will be able to delete other registered fingers and disassociate usernames and passwords from login pages.

Several limitations with the system were noted. The system assumes that the user is always the same person. This is because it is limited to 10 scans per user login (although there is nothing to stop you from registering 10 fingers from 10 different people). There is no way to associate a single registered finger with a login page. All registered fingers are associated. The Microsoft fingerprint reader does not work with browsers other than Internet Explorer. Other scanners on the market will work but the management of such systems at remote sites would be difficult to control without a significant investment in time and effort.

Other systems considered included the use of PIN numbers, signature and other biometric data. For various practical reasons however, including cost, reliability and general availability, it was decided to use video and chat in order to establish and verify the identity of online candidates. In the next stage we describe the development of our system.

Development of an online verification system

The next stage of our study was to develop and implement an online identity verification system using video conferencing, a database of user verification information and online chat. Video has been used in several contexts in supporting online education. It has been used for a range of activities such as interviewing for PhD candidates from overseas (Basiel 2006), team meetings, project supervisions, and focus group sessions. Mostly, it is used for pedagogical, motivational, and content/information delivery. In this study we decided to develop and use an online video streaming system using web cams, integrated with online chat in order to verify the identity of test

candidates. The system developed was in two main parts, a management system and a client side application. The system employed readily available Skype video and chat software integrated with the well-known Questionmark Perception assessment software and an online verification database built for the purpose. The test comprised of “reading comprehension” questions loosely based on the book “DaVinci Code”. However, no prior knowledge of book was required. The assessment was set up primarily as a reading comprehension exercise and the topic was picked at random. Figure 3 is a screenshot of the test used for the two sessions.

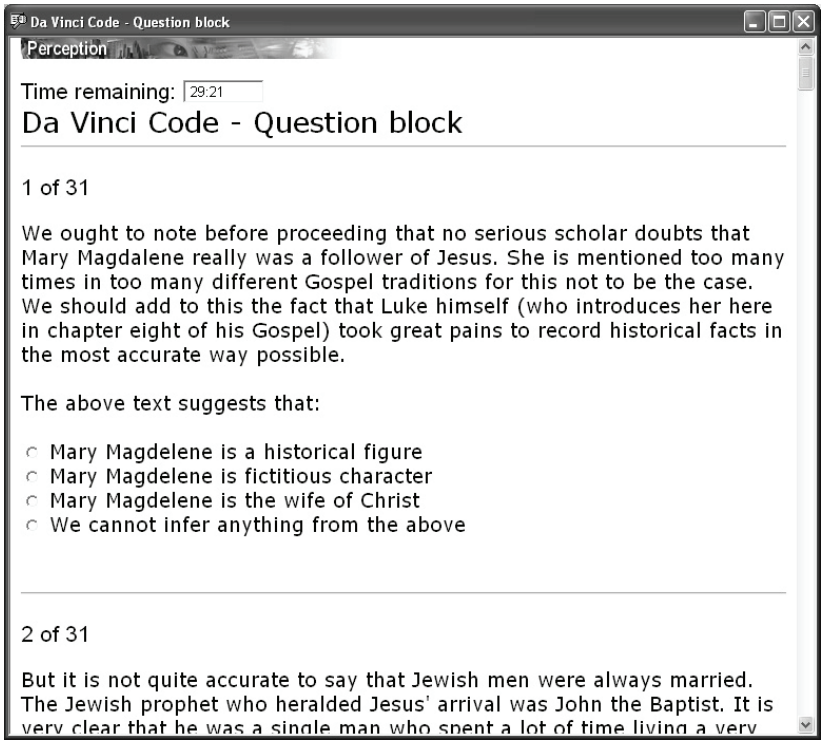

Figure 3 Screenshot of the “DaVinci Code” reading comprehension test

Pilot study

Two studies were conducted in order to develop and test this system. In the first study, an expert evaluation of the software system was undertaken in order to refine and test the system and evaluation tools.

Comments from the expert evaluators were in general favourable, though potential problems were identified:

> "The experience of using the video online test was an interesting one. It was not as intrusive as I had imagined it to be. The small interface makes it easy to launch/operate and carry on with my test at the same time. I did have to pay extra attention (and thus, becomes a bit of a distraction) while I was trying to concentrate on the test questions as I would never know when the video would pop up again. Another issue with using the video is that it was not clear if I were to look up on the web cam to acknowledge the moderator. For the most part, it worked rather smoothly and didn't cause extra stress or major distraction to my overall testing experience." *(Educational Systems analyst)*

> "For such a short test [35 minutes] I considered the amount of intrusions to be excessive. Although I had finished about ten minutes early I was still interrupted whilst answering questions on at least two occasions. My other concern was that the Skype interface is somewhat confusing and I was spending too much time trying to work out what button to press. Starting the incoming voice call was fine but then I was forgetting to press the 'Start Video' button to activate the webcam. It might be useful to include a run-through of what exactly will happen when a call occurs." *(Technical specialist)*

Full study

In the second study, 23 undergraduate students undertook an online assessment using the system under controlled laboratory conditions. The session was managed by the same moderator who managed the first pilot study. The students were introduced to the study by the moderator who read from a scripted introductory sheet. The procedures and aims of the study were explained at this stage, the system was briefly demonstrated and questions were responded to.

At the start of the assessment session, each participant started the test by logging in to the QM Perception application. They were each contacted initially using video by the moderator in order to provide a visual comparison with a photograph held in the database. Once this had been established, subsequent communication was through chat and video requiring responses to questions.

All interactions between the management system and the candidate group were captured and recorded for later analysis. The session was also recorded using a video and audio recorder in order to assess the environment and conduct of the session. It was hoped to ensure in this way that bias was not introduced into the trial and to record any difficulties participants and testers might experience. A user questionnaire was handed out at the end of the session, as we wanted to obtain feedback from users on the test and the verification process. Measures were made of the efficiency of the system, in

terms of the speed and reliability of the verification process. The session moderator also provided a reflective log of the session in order to record his experiences of managing the session. In table 1, the results of the student questionnaire are presented.

Table 1 Student attitude to online assessment and identity verification

Variable	**Degree**				
	Not Much		**Average**		**Very much**
Experience:	**1**	**2**	**3**	**4**	**5**
Using Computer	**7%**		**7%**	**13%**	**73%**
Using Internet	**7%**		**7%**	**13%**	**73%**
Assessment Online	**20%**	**7%**	**27%**	**27%**	**20%**
Video Conferencing	**27%**	**20%**	**7%**	**27%**	**20%**
Online Chat	**7%**		**13%**	**27%**	**53%**
	Poor				**Excellent**
Quality of Assessment			**7%**	**67%**	**20%**
	Easy				**Difficult**
Difficulty of Questions		**13%**	**40%**	**27%**	**20%**
Starting the Session was	**40%**	**33%**	**13%**		**13%**
	Disagree				**Agree**
	7%	**13%**	**20%**	**27%**	**33%**
Identity checking didn't affect performance		**20%**	**7%**	**7%**	**67%**
Using video was a problem	**60%**	**27%**	**7%**	**7%**	
Online chat was a problem	**73%**	**13%**	**13%**		
Often distracted by need to confirm identity	**53%**	**13%**	**13%**	**20%**	
Difficult to know what to do at times	**60%**	**20%**	**13%**	**7%**	
Easy to answer questions, despite interruptions	**7%**	**20%**	**20%**	**20%**	**33%**
Sometimes missed the video or chat	**60%**	**7%**	**27%**	**7%**	
Messages were clear and easy to follow			**7%**	**20%**	**73%**
Using video was easy			**7%**	**33%**	**60%**
Using online chat was easy			**20%**	**27%**	**53%**
Easy to remember details I was asked for during the assessment		**7%**	**27%**	**20%**	**47%**
Too many screen to deal with in the session	**80%**	**13%**	**7%**		
Need to validate identity had a large effect on my performance	**53%**		**20%**	**20%**	**7%**

The results of the student questionnaire shown in table 1 were taken to indicate that the use of the online video and chat identity verification process did not unduly interfere with their experience of the assessment. The range of test scores obtained in the study suggested that the level of the test was adequate to provide a good measure of the quality of the identity system.

Analysis of the interaction data recorded showed that it was possible to make approximately one interaction each minute between the session moderator and the candidates in the 39 minutes the session lasted (26 video and 12 chat sessions in all). This was surprisingly few. Video connections lasted on average about 10 seconds; just time enough for the candidate to respond and the session manager to confirm identity by comparing the video image with the database image. Chat sessions lasted slightly longer, about 15 seconds, due to the need to enter text and also because the request to chat was less noticeable than the request to initiate a video session within the interface.

The most common administration function was searching (33 searches), which took on average 31 seconds for each. Searching involved locating information on candidates held in the database and locating and initiating contact with the candidates on the video and chat system in order to make connections. There were 9 errors in total, occupying on average 84 seconds each. At approximately one every 4 minutes, we considered this to be a large number of errors. The software and hardware was installed on good quality computers in a controlled environment by skilled technical support workers.

Errors mostly related to loss of the video and chat connection due to problems with the software employed for this purpose. In some cases, these were probably due to user error, but mostly they were due to errors of an unspecified nature within the software itself. These errors were resolved by re-starting the software and making connection once more. There were no errors due to loss of network connection *per se*. In order to correct error, helpers were employed to visit each assessment workstation, locate the reason for the error and re-set the software. This would not be possible in a full scale test with remote candidates. It is likely that suitably trained candidates would be able to detect loss of connection and make the necessary reconnections themselves. There were no errors identified that related to the use or function of the management system or the question delivery software. It would be important in a full scale assessment session to test systems adequately prior to the start of a test session, to train candidates in the use of the software and remedial action and also to have a standby method in case a catastrophic error resulting in total loss of communication with a candidate occurred.

Conclusion

The results of the study were able to identify potential problems and sources of error in the systems employed and also provided potential solutions to them. Learners in general did not report that they were disadvantaged by the video and chat system. A major improvement will be to develop a fully integrated system based on the use of video and chat for the verification of identity with many of the functions fully automated. This will improve the efficiency and reduce error rate. A need to train examinees was also identified. In the next stage of our research, we shall implement improved systems for full-scale testing with remote learners in Trinidad. We are not able to ensure that all learners will have a broadband connection and this will introduce additional challenges.

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Biography

Trevor Barker is a lecturer in Computer Science at the University of Hertfordshire. He obtained his PhD in Computer Sciences at this university for research into student models and multimedia learning applications.