

M-QUIZ BY SMS WITH CHEAT PREVENTION FEATURE

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Abstract - Virtual learning is a new idea that has gotten a new form with the emergence of new technologies such as the wireless networks. The mobile phone (cell phone) is a device that is used by most people nowadays. Therefore, one can use the mobile phone for virtual learning on a wide scale. One of the popular and at the same time simple and inexpensive services on the mobile phone is the SMS (Short Message Service). In this paper, we propose a method for taking multiple-choice quizzes by using the SMS on mobile phones. In the provision of these tests, after coding the questions with a key, some SMS messages were sent to the student along with the answers of the questions, which were steganography in an image. The student, after receiving and answering the questions, receives his grade at the client-side and then the grade and student answers are hidden in an SMS picture message and sent back to the instructor. Also, the location of student and the time that he took the exam are sent to the instructor by another SMS to prevent the possibility of any cheating. Moreover, the correct answers of the questions are destroyed within the image after they are extracted from image so as to eliminate the possibility of any cheating. The instructor also, after receiving the image and extracting the grade, records the student's grade. Moreover, the instructor can find any cheating by comparing students locations, times they took the exam and their answers. Because of using the steganography method in sending the answers and grades, and also sending the student's location and time of quiz, this method is highly secure and the possibility of cheating in the exam is reduced. This method was implemented with the J2ME language on a Nokia 3250 mobile phone.

Keywords - Cheat Prevention, SMS (Short Message Service), Mobile Phone, M-Learning, Steganography, Location Based Services.

INTRODUCTION

The method of learning in the last several decades has undergone many changes and developments. Transition from the old systems of learning to the modern methods of learning has been the concern of many instructors and students. Meanwhile, virtual learning has received attention because of the large extent of the Internet. The main cause of this is the possibility it provides for the individuals to have communication from far away and to reduce some expenses (although some other expenses and special grounds are needed).

Along with the Internet, wireless networks such as the mobile phone are growing rapidly. Today, one out of each six persons in the world has a mobile phone. As a result, these systems can be used for learning [1,2]. However, the important problem is to find appropriate structures for implementing learning systems on such devices while considering their limitations.

One of the popular services on the mobile phone is the SMS (Short Message Service). The SMS is the transfer and exchange of short text messages between mobile phones. In this service, one can also send binary images with a 72×28 -pixel size in binary messages. These messages are carried out indirectly and by a component known as the SMSC [3]. The SMS has such advantages as low cost, offline SMS sending, exchanging SMS simultaneously with establishing telephone contacts, etc.

According to the above statements, a method has been provided in this paper for taking multiple-choice quizzes through the mobile phone and by using the SMS so that the questions are sent as SMS messages by the instructor to the student, the student answers the questions and then the grade and answers are sent back by an SMS to the instructor [2]. In addition, the location of the student is sent to prevent cheating. To send the answers of the student (along with the questions), with the objective of obtaining the grades on the client-side, a method of steganography of grades within an SMS picture message is used so as to prevent cheating by the student. Moreover, after extracting the answers of the questions, information within the message is destroyed. Also, the student's grade is sent to the instructor by using the method of steganography so as to maintain the security of the grade. Moreover, the location of student is sent to the instructor. So, if the locations of two students are near and also some of their questions and answers are equal, the instructor can guess that students were involved in cheating. We will talk about our proposed method in the section entitled, "OUR PROPOSED ALGORITHM."

As most people have mobile phones and the SMS is a popular service, this method covers a wide spectrum of users. In addition, the cost of SMS is very low and any student has to send only two SMS messages that contain his grade. The section, "ADVANTAGES" contains discussions on the advantages of this plan.

Our proposed method was implemented with the J2ME language on a Nokia 3250 mobile phone. The details are provided in the section, "EXPERIMENTAL RESULTS."

The following section contains a study of the works performed in this respect. The final section embodies the final conclusions of the study.

RELATED WORKS

Most work performed in M-learning and especially taking quizzes has been done by using technologies such as WAP (Wireless Application Protocol). For the use of the SMS for learning, see references [4] and [5]. Also, we did not find any published work on the

methods of preventing cheating in M-Quizes. However, the only work reported on M-quiz by SMS is reference [6]. A summary of the work performed by it is as follows:

In this method, questions are shown to the students in PowerPoint slides. Then, the students answer the questions by SMS in certain formats. The questions are in one of these four forms: single-choice, multiple-choice, fill-in-the-blank and matching two lists. Finally the students should be connected to the Internet by a computer and get their test results.

We will provide a full description of our proposed method in, "OUR PROPOSED ALGORITHM." However, here we briefly mention the differences of our method with this method:

1. In our proposed method, the questions are also sent by SMS.
2. In this method, the students refer to the Internet to view their grades while, in our proposed method, the answers of the questions are sent in steganography form and the student, after answering the questions, sees his results on the client-side without communicating with his instructor. Then, at the end, the test grade is sent to the instructor in an stegano image, in which the data is hidden by using steganography method.
3. In this method, the answers of the questions are sent without any security consideration while, in our method, the answers of the questions and also the student's grade are sent in an stegano image, which contributes to the security of the testing.
4. In our proposed method, the possibility of cheating is reduced by sending the locations of students to the instructor to prevent accompany of students during quiz.

OUR PROPOSED ALGORITHM

In this project, our aim is multiple-choice quizzing by SMS so that the student receives the questions by SMS and, after answering the questions, receives the result of the test on the client-side. The result is, then, sent to the instructor along with the location of student and the time which the student took the exam. The full details of this project are as follows:

At the beginning, the instructor has to prepare the test questions and students' answers on his computer. As the questions have to be sent to the students by SMS, the instructor should install an SMS gateway on his computer so as to be able to send and receive the SMS messages. The instructor, in turn, saves the student numbers of all the students and their mobile phone numbers in a file. Then, by providing the questions and students' answers and also a file containing the mobile phone numbers of the students, which we will explain later, he will send the questions to the students.

After receiving the questions and their answers, if the total number of the questions is more than what should be sent for the students, e.g. the total number of questions is 20 and for each student 5 questions have to be sent, then the program randomly selects 5

questions for each student and displaces the choices of each question so that the students' questions will be different from each other. The numbers of questions for each student are saved on the instructor computer to analyze students' answers later and also to check the possibility of cheating when two students are in the same location during the exam. Before sending the questions, they are encrypted with a key, which provides the answers of questions, e.g. 13324 is the key. Now, if the number of questions is n , the program will prepare $n+1$ SMS messages, and the questions are in the second SMS message to $n+1^{\text{th}}$ SMS message. There is a picture in the first SMS message (which will be explained later), in which the answers of the tests are hidden by using the steganography method.

Steganography means hiding information in a cover media so that the others will not notice that such information exists. Here, we, by using the method of steganography in the SMS, hide the test answers in an SMS picture message. The method of SMS steganography is fully described in references [7,8]. Briefly speaking, in this method, in order to hide information in an SMS picture message, the picture is divided into smaller blocks. If the change of the pixels of the block is not noticeable, a pixel of the block is changed and, thus, information is hidden in the picture. There is also a password based on which data are encoded.

In this project, the test answers and also the exam time are hidden in the picture so that the students cannot extract the answers.

The amount of information capable of being hidden in SMS is limited. On the one hand, the picture selected for hiding information contains the quiz number as well, i.e. "Quiz 1" and hiding information in a text is clear. Therefore, margins are put around the picture to hide the information.

An SMS picture message contains 234 blocks of 3×3 and a maximum of one bit of information can be hidden in each block. If one quarter of the picture contained the above phrase (58 blocks), 176 blocks remain for hiding the information. As some blocks are incapable of hiding information, if only $1/3^{\text{rd}}$ of blocks were capable of hiding information, about 50 blocks remain for hiding information. In order to hide the time of examination, assuming that the exam lasts 256 minutes to the maximum (usually the time of quizzes is short), we need 8 bits or an equivalent of 8 blocks. In order to hide the answer of each 4-choice question, we need 2 bits or an equivalent of 2 blocks. Therefore, up to 20 answers can be hidden in each picture message, because 40 blocks are needed for 20 questions. Considering the 8 blocks needed for hiding the time of exam, a total of 48 blocks is needed. Therefore, 50 blocks are capable of hiding information up to 20 questions. So, an SMS picture message is proper for sending time of examination and answers of questions up to a maximum of 20 questions.

Also, since the test answers are sent to the student, the student does not need to send the answers to the instructor and then receive a grade from the instructor. But, after answering the questions, he sees his grade at the same moment and has to send, later, his

test grade with the test answers so that the instructor will be able to analyze students' answers at a later time. The details will be provided later.

When $n+1$ SMS messages are prepared, all the SMS messages are sent to the appropriate student. This is applied separately for all the students. The student receives the SMS messages by the special program that is installed on his mobile phone. The program gives time to the student to answer the received questions within a certain period of time extracted from inside the first SMS picture message. Before that, the questions are decoded from SMS with a password key. The password key is based on the answers of questions, which are extracted from the SMS picture message. References [7,8] provide how information is extracted from the picture containing steganography information.

Now, the program shows the SMS messages respectively and receives answers from the student. After the student answers all the questions, the program provides the grade and the grade along with the answers are hidden in an SMS picture message and sent back to the instructor. The picture used for hiding the grade is the same as the first SMS picture message. The instructor's telephone number is specified according to the received SMS messages. Thus, even if the student is not able to send the SMS message at that moment, he can send the result to the instructor later without letting the quiz be interrupted by this. Moreover, after extracting the appropriate answers from the first SMS picture message, the answers within the SMS message are destroyed (stealth data). This makes it impossible for the student to further take the quiz.

Along with the answers to questions, another SMS is sent for the instructor, which shows the geographical location of the student. This prevents the students from cheating because the method used is asynchronous and the students can take part in the exam any time and from any place [9]. Therefore, cheating is impossible. Thus, the instructor asks the students in advance to keep a distance of at least 4 meters, which is equal to being in separate rooms. When the students take the quiz, the program automatically sends an SMS defining the location of the student to the instructor. After receiving answers and the location of the students, the instructor compares the places. If two students had participated in the exam from a place close to one another, the instructor will then compare the questions (the numbers of which have been stored in advance) and the answers to the questions as received through the SMS and if more than 20% of the questions and answers were identical, he should guess a cheating and send a warning to the concerned two students. If they had not cheated, they would present their reasons. Of course, it should be noted that questions are randomly selected from a large bank and it is improbable to have similar questions for two students and, therefore, the possibility of cheating is also very low.

In order to locate the student, it is not necessary to use the GPS system, because in spite of the high precision and accuracy of GPS, this system does not act well in indoor areas while the students usually go to covered places such as their room or the library for exam [10]. On the other hand, the GPS system is not available on mobile phones and it

needs a separate device, which increases the expenses of the students. Therefore, it is more convenient to use the network location services, although they are less precise.

Now, the instructor receives the SMS picture message containing the student's grade and answers, and, after extracting them from the picture, records the grade and answers with the use of an appropriate program.

The instructor has received an SMS showing the place of the student and will be able to identify the probable cases of cheating by comparing the location and the exam time of the students.

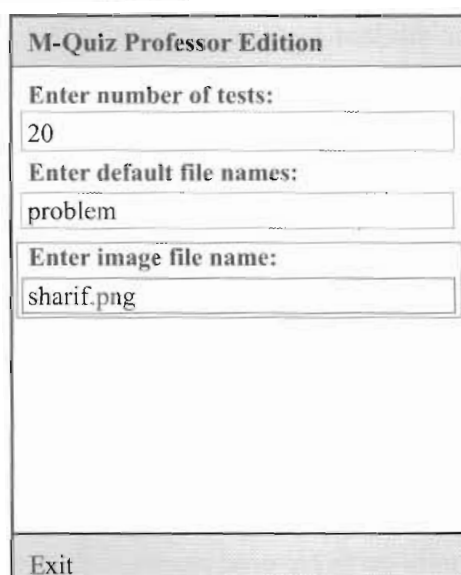
The student's specifications are extracted according to his mobile phone number from the file in which the personal information of each student and his mobile phone number have already been saved.

EXPERIMENTAL RESULTS

This project provides a method for taking multiple-choice quizzes by SMS, in which the steganography is used for increasing the security of the exchange of questions and grades. Also, the location based services are used to reduce the possibility of cheating.

To implement the method, the J2ME (Java 2 Micro Edition) programming language was used. This language is a special version of the Java language for small devices such as the mobile phone and PDA. The project consists of two separate programs, one for the instructor and one for the student.

In the instructor's program, first the program receives the questions (which are up to 20) from the instructor. A small picture (for steganography of the answers and quiz time) is also received from the instructor, which is the number of quiz and an special boarder (Figure 1). Then, the program reads the mobile phone number and the student number of each student from a file containing information related to each student.



The screenshot shows a mobile application window titled "M-Quiz Professor Edition". It contains three input fields for configuration: "Enter number of tests:" with the value "20", "Enter default file names:" with the value "problem", and "Enter image file name:" with the value "sharif.png". Below these fields is a large empty rectangular area. At the bottom of the window is an "Exit" button.

Figure 1: An screenshot of instructor's program.

The program first selects 5 questions for each student while following the algorithm provided in “OUR PROPOSED ALGORITHM” and displaces the answers. Then, it saves the question numbers. The steganography program, which is run separately, hides the answers and the time of the quiz in the received picture. This picture is now sent, along with five prepared questions, to all students.

In the student’s program, which is run on his mobile phone, six SMS messages are received. First, from inside the first SMS picture message, the duration of the quiz and the answers of the questions are extracted by the SMS data extraction program—which is run separately—and the data within the picture is destroyed. The quiz questions are decrypted using the answers of questions, which are extracted from the first SMS as the key. Then, the questions are shown to the student respectively (Figure 2). The student has to enter the answers within the determined period of time.

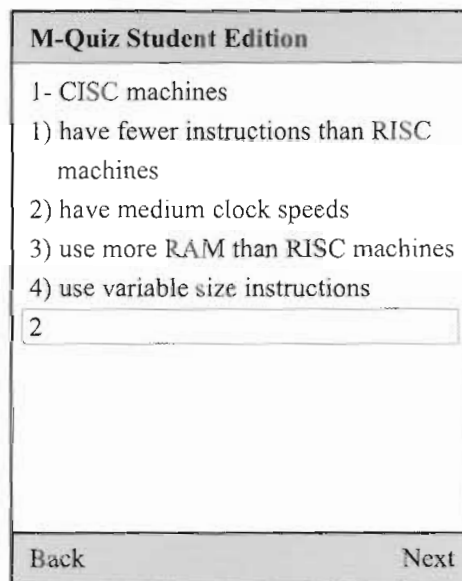


Figure 2: An screenshot of student’s program.

At the end, the student’s answers are compared with the correct answers and the student is given a grade. The grade and answers are hidden by the steganography program separately in the first SMS picture message. The SMS picture message is sent to the instructor. Also, the location of student and the time which the student took the exam are sent to the instructor by an SMS. The instructor runs the SMS data extraction program to extract and record the student’s grade and answers. Both the instructor’s and the student’s programs were run on a Nokia 3250 mobile phone.

ADVANTAGES

In this section, some advantages of our method are mentioned:

1. The mobile phone is a public facility and most individuals have mobile phones. On

the other hand, the SMS is a popular service. Therefore, our proposed method covers a wide spectrum of students.

2. The SMS is an inexpensive service.
3. To take the quiz, each student only needs to send two SMS messages in order to send the grade. Also, all the quiz processes are carried out on the student's mobile phone, i.e., in general, this method is a client-side method. Therefore, this method has low costs for the student and, because of lack of too many exchanges of questions and answers between the student and the instructor, the security of the quiz is high.
4. By using steganography in SMS picture messages, the security of this project for sending the correct answers and the final grade has been improved.
5. By destroying the hidden correct answers in SMS picture messages after extracting the answers from the picture, any misuse will be made difficult.
6. Because of not using sophisticated technologies, this method can be implemented on simple mobile phones as well and there is no need to use advanced mobile phones.
7. By the use of locating system, the possibility of cheating in examination has decreased. Also, due to different and random selection of questions, the possibility of cheating is very low.

CONCLUSIONS

This paper provides a method for taking multiple-choice quizzes by SMS. By using SMS steganography, the test security has been improved as well. And also by using location based services, the possibility of cheating is reduced.

In addition to mobile phones, this method can be used on other devices such as PDAs. The proposed method not only can be used for taking multiple-choice tests, but it can also be used for tests with descriptive or short answers.

Because of the low costs of this method for the student, it can be used in poor regions as well. Also, as only two contacts between the student and instructor are required (one for receiving the questions and the other for sending the grade), even if a telephone contact cannot be established by the student's mobile phone, the quiz will not be disrupted. Therefore, this method can be applied even at times such as travels and flights.

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