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Application of Multiplicative Random Number Generator (MRNG) Algorithm in Build Semester Exam Application

Yusuf Ramadhan Nasution[1], M. Fakhriza[2], Merlin Sitanggang[3]
[1,2,3]Department of Computer Science, State Islamic University of North Sumatera

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ABSTRACT

In the world of education, exams are used to measure how well students have achieved their educational goals. This allows students to determine their level of understanding of the subject they are pursuing. If the results are found to be suboptimal, the learning process should be improved. A semester exam is an activity conducted to assess a student's development during the completed training period. MTs Persiapan Negeri 4 Medan is one of the educational institutions that conducts semester exams according to the Paper Pencil Test (PPT) model exam system. PPT is a traditional form of administration as all students are given the same test tasks. However, this review system has its drawbacks. The drawback of the question lies in the procurement of exam questions and answer sheets, which wastes paper and takes a lot of time. Also, their administration requires a lot of manpower to proctor the exams and specialized staff to revise the answer sheets and prepare the exam results. In this study, we will implement a Multiplicative Random Number Generator (MRNG) method to create a mobile-based semester exam application on MTs Persiapan Negeri 4. The designed application aims to overcome problems encountered in traditional exams, so there is no need to procure questionnaires or answer sheets, and no special staff is required to correct answer sheets

Corresponding Author:

Merlin Sitanggang,
Department of Computer Science,
Universitas Islam Negeri Sumatera Utara, Medan, Indonesia
Email: merlin.stg01@gmail.com

1. INTRODUCTION

According to the Big Indonesian Dictionary (KBBI), the notion of an exam is something that is used to test the quality of something (smartness, ability, learning outcomes). [1] Exams are actually a measuring tool to measure a student's learning success. Like measuring instruments, exams must also have accuracy and precision. [4] Final Semester Examination is an activity carried out by educators to measure students' competency achievement at the end of the semester. [7].

MTs Persiapan Negeri 4 Medan is one of the educational institutions that organizes semester exams using the Paper-Penciltest (PPT) model exam system. PPT is the conventional form of administration as all candidates are provided with the same test items. However, this exam system has drawbacks. The drawback is in procuring test question sheets and answer sheets which consumes paper and takes time, in practice it also requires many teachers to supervise the exams. Also requires special staff to correct answer sheets and evaluate exam results. For this reason, a solution is needed to overcome the problems identified during exam activities at the MTs Persiapan Negeri 4 Medan School.

Application is a software that becomes the front end of a system that is used to process data into useful information for the people and the system concerned. [3]

Android is an operating system for Linux-based mobile devices that includes an operating system, middleware and applications. Android is an open platform that allows developers to create their applications. [5]. Android is a mobile operating system based on a modified version of linux. Almost all smartphones have an Android operating system. In its development, Android has experienced quite a lot of updates since it was first released. [6]

In this study, researchers will also apply a randomization method to randomize exam questions. The method used is the Multiplicative Random Number Generator (MRNG). By implementing MRNG, exam questions will be displayed randomly between one and the other students

2. RESEARCH METHODE

This research in general is research that aims to develop a mobile-based semester exam application. The research method used in this study is the Research and Development (R&D) method. R&D method is a research method used to produce certain products, and to test the effectiveness of these products. Educational products such as curricula for specific educational purposes, teaching methods, learning media, textbooks, modules, assessment systems, proficiency test models, etc. In this study, an application will be built that can be used for semester exams.

2.1 System Planning

The Semester Examination Application at the MTs Persiapan Negeri 4 Medan School which will be built in this study uses the Multiplicative Random Number Generator (MRNG) algorithm to randomize the semester exam questions that will be displayed. The system stages in displaying semester exam questions can be seen in the flowchart as follows:

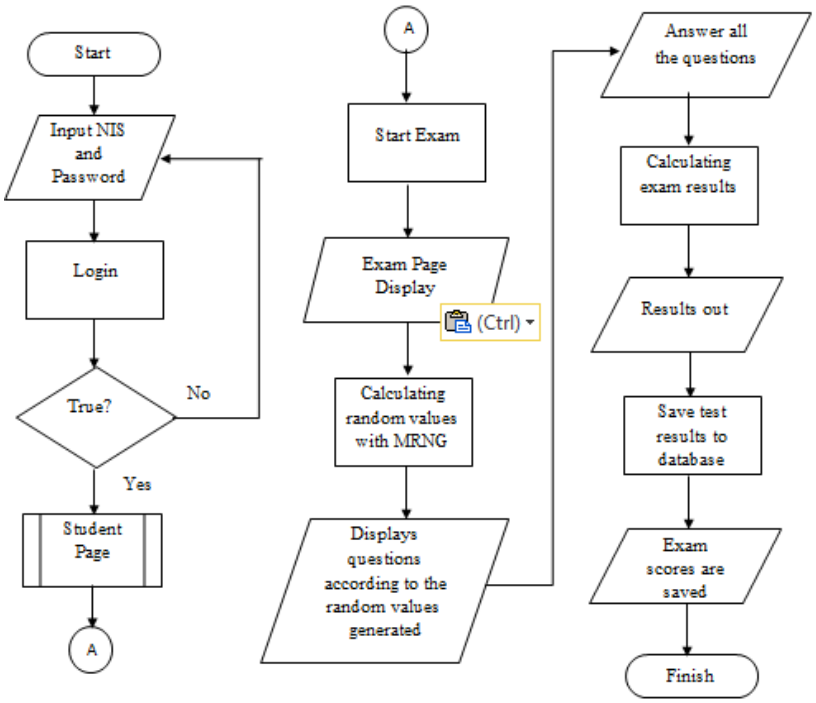


Figure 1. Semester Exam Application Flowchart

2.2 Multiplicative Random Number Generator (MRNG)

A Random Number Generator is a tool or algorithm that generates a statistically independent and unpredictable sequence of numbers. In simple terms, a Random Number Generator is a program or tool for generating random number sequences or symbols. This system has been applied to various fields, such as statistical sampling, computational simulation, cryptography, and even design. The RNG method used in this application is the Multiplicative RNG Method (MRNG), which is a random number generated using a mathematical formula that is repeated as needed.

The formula for the RNG multiplicative (MRNG) algorithm is:

$$Zi + 1 = (a.Zi + c) \bmod m \quad (1)$$

The random number generated are = R1, R2, R3, R4
Provision :

1) Choose a constant multiplier a
2) Choose Z0
3) For the first random number then Zi ➛ Z0
4) Choose c
   C is an odd number and not multiple of m
5) Choose m
   note : in the iteration process, a, c, and m, are constant. [2]

3. RESULT AND ANALYSIS

The data used in this study were in the form of semester exam questions for class VII Aqidah Akhlak subject with a choice of 50 multiple choice questions, 20 essay questions and 20 true or false choice questions. The questions will be randomized according to the order when students take the semester exams. The randomization of the questions was carried out using the MRNG algorithm.

3.1. Multiple Choice Questions

In randomizing multiple choice questions, the constant value a = 1 and the constant value c = 7. The value m will be 50 because there are 50 multiple choice questions. In the system to be built, the first question displayed will be randomized between question number 1 to question number 50. If the first question that appears is question order 5 in the question array, the following is the order of questions that will appear based on the calculation of the MRNG algorithm:

Z (0) = 5
Z (1) = (1 * 5 + 7) mod 50 = 12
Z (2) = (1 * 12 + 7) mod 50= 19
Z (3) = (1 * 19 + 7) mod 50 = 26
Z (4) = (1 * 26 + 7) mod 50 = 33
Z (5) = (1 * 33 + 7) mod 50 = 40
Z (6) = (1 * 40 + 7) mod 50 = 47
Z (7) = (1 * 47 + 7) mod 50 = 4
Z (8) = (1 * 4 + 7) mod 50 = 11
Z (9) = (1 * 11 + 7) mod 50 = 18
Z (10) = (1 * 18 + 7) mod 50 = 25
Z (11) = (1 * 25 + 7) mod 50 = 32
Z (12) = (1 * 32 + 7) mod 50 = 39
Z (13) = (1 * 39 + 7) mod 50 = 46
Z (14) = (1 * 46 + 7) mod 50 = 3
Z (15) = (1 * 3 + 7) mod 50 = 10
Z (16) = (1 * 10 + 7) mod 50 = 17
Z (17) = (1 * 17 + 7) mod 50 = 24
Z (18) = (1 * 24 + 7) mod 50 = 31
Z (19) = (1 * 31 + 7) mod 50 = 38
Z (20) = (1 * 38 + 7) mod 50 = 45
Z (21) = (1 * 45 + 7) mod 50 = 2
Z (22) = (1 * 2 + 7) mod 50 = 9
Z (23) = (1 * 9 + 7) mod 50 = 16
Z (24) = (1 * 16 + 7) mod 50 = 23
Z (25) = (1 * 23 + 7) mod 50 = 30
Z (26) = (1 * 30 + 7) mod 50 = 37
Z (27) = (1 * 37 + 7) mod 50 = 44
Z (28) = (1 * 44 + 7) mod 50 = 1
Z (29) = (1 * 1 + 7) mod 50 = 8
Z (30) = (1 * 8 + 7) mod 50 = 15

Z (31) = (1 * 15 + 7) mod 50 = 22
Z (32) = (1 * 22 + 7) mod 50 = 29
Z (33) = (1 * 29 + 7) mod 50 = 36
Z (34) = (1 * 36 + 7) mod 50 = 43
Z (35) = (1 * 43 + 7) mod 50 = 0
Z (36) = (1 * 0 + 7) mod 50 = 7
Z (37) = (1 * 7 + 7) mod 50 = 14
Z (38) = (1 * 14 + 7) mod 50 = 21
Z (39) = (1 * 21 + 7) mod 50 = 28
Z (40) = (1 * 28 + 7) mod 50 = 35
Z (41) = (1 * 35 + 7) mod 50 = 42
Z (42) = (1 * 42 + 7) mod 50 = 49
Z (43) = (1 * 49 + 7) mod 50 = 6
Z (44) = (1 * 6 + 7) mod 50 = 13
Z (45) = (1 * 13 + 7) mod 50 = 20
Z (46) = (1 * 20 + 7) mod 50 = 27
Z (47) = (1 * 27 + 7) mod 50 = 34
Z (48) = (1 * 34 + 7) mod 50 = 41
Z (49) = (1 * 41 + 7) mod 50 = 48

By using the MRNG algorithm, the sequence of multiple choice exam questions that will be displayed is 5, 12, 19, 26, 33, 40, 47, 4, 11, 18, 25, 32, 39, 46, 3, 10, 17, 24, 31, 38, 45, 2, 9, 16, 23, 30, 37, 44, 1, 8, 15, 22, 29, 36, 43, 0, 7, 14, 21, 28, 35, 42 , 49, 6, 13, 20, 27, 34, 41 and 48. The order of the questions will be adjusted to the order of the questions in the question array obtained from the system database. For further display to students who carry out semester exams.

3.2. Essay Questions

If the order of the first question that appears is 5, then the next questions that appear are:
Z(0) = 5
Z(1) = (1 * 5 + 7) mod 20 = 12
Z(2) = (1 * 12 + 7) mod 20 = 19
Z(3) = (1 * 19 + 7) mod 20 = 6
Z(4) = (1 * 6 + 7) mod 20 = 13

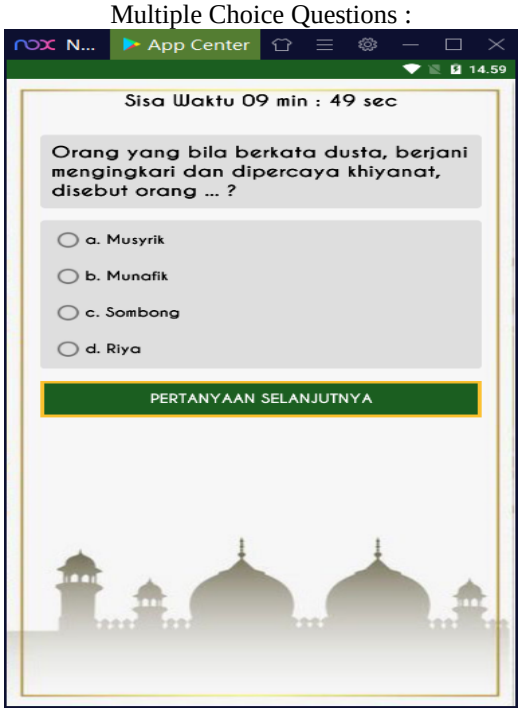
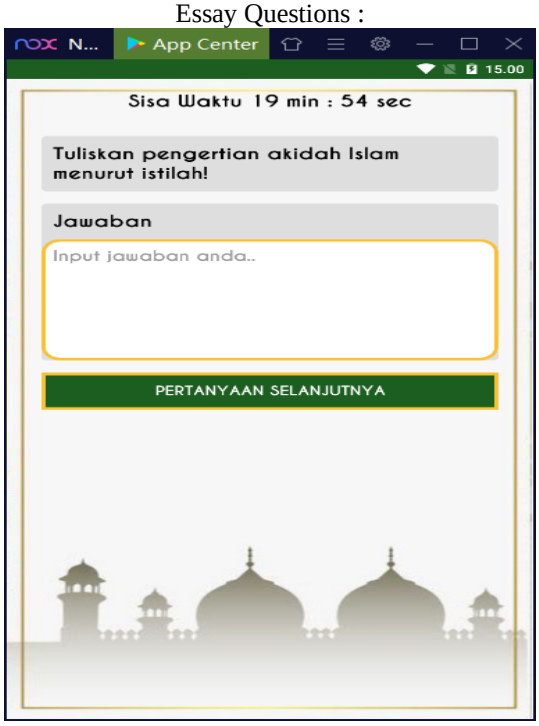
3.3. True or False Questions

If the order of the first question that appears is 5, then the next questions that appear are:
Z(0) = 5
Z(1) = (1 * 5 + 7) mod 20 = 12
Z(2) = (1 * 12 + 7) mod 20 = 19
Z(3) = (1 * 19 + 7) mod 20 = 6
Z(4) = (1 * 6 + 7) mod 20 = 13
Z(5) = (1 * 13 + 7) mod 20 = 0
Z(6) = (1 * 0 + 7) mod 20 = 7
Z(7) = (1 * 7 + 7) mod 20 = 14
Z(8) = (1 * 14 + 7) mod 20 = 1
Z(9) = (1 * 1 + 7) mod 20 = 8
Z(10) = (1 * 8 + 7) mod 20 = 15
Z(11) = (1 * 15 + 7) mod 20 = 2
Z(12) = (1 * 2 + 7) mod 20 = 9
Z(13) = (1 * 9 + 7) mod 20 = 16
Z(14) = (1 * 16 + 7) mod 20 = 3
Z(15) = (1 * 3 + 7) mod 20 = 10
Z(16) = (1 * 10 + 7) mod 20 = 17
Z(17) = (1 * 17 + 7) mod 20 = 4
Z(18) = (1 * 4 + 7) mod 20 = 11
Z(19) = (1 * 11 + 7) mod 20 = 18

3.4 Application Testing

In the testing process, it will try to display multiple choice questions, essay questions, and true or false choice questions. The results of application testing can be seen in the following Table 1:

Table 1. Application Testing

No.	Application Testing
1	Multiple Choice Questions : 
2	Essay Questions : 
3	True or False Question :

4. CONCLUSIOON

The use of this mobile-based semester exam application is able to replace the conventional system previously used at MTs Preparation Negeri 4 Medan which only requires a smartphone from each student. The automatic correction system has also replaced the old system which still requires time and effort to correct student answer sheets.

Randomizing the order of questions using the Multiplicative Random Number Generator (MRNG) algorithm is proven to display the order of questions randomly and without repetition. So that the formation of questions when students carry out the exam will be random and will not be in the same order as other students. So that the implementation using this application becomes more effective, efficient and minimizes the occurrence of fraud between one student and another student.

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