Internet-based Exam Generator for Practice Review of the Fundamentals in Engineering Exam

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Abstract

One of the more important aspects of reviewing for any exam is to practice test taking. However, this is difficult parts for any instructor to develop. Furthermore, once used, it cannot be reused without modification. This becomes ever more critical when trying to develop an Internet-based review system. To solve this, a problem generator program has been developed that generates random questions on different engineering topics. Many web-based test sites choose problems from an already existing set of problems. This program uses a set of problem templates that, when accessed, generates different variables of the same question. The generator program changes the problems' variables, order and answers. It even generates new graphics for the problems. The generator program uses various computer programs such as PERL, JavaScript, CGI, Flash Generator, HTML, and graphic programs.

There are four major advantages of using this test generating program. First, the program creates more exams than one can put into a problem data bank. Second, each user can get different exams at the same time by allowing the computer to randomly choose the problem templates. Third, the scores and answers are available immediately, since the system checks the answers and records the scores. And last, log files are created for each exam to allow the user to review previous tests and learn from mistakes.

I. Introduction

The Fundamentals of Engineering (previously called the Engineer-In-Training or EIT exam) is one of the more important tests for any engineering student. The Fundamentals of Engineering (FE) examination is administered twice a year in April and October. The examination is divided into a morning four-hour session and an afternoon four-hour session. There are 120 questions to be answered in the morning section and 60 questions in the afternoon section.[1,2] Approximately, 50,000 engineers take the FE exam annually, half of whom are new graduate engineers in the U.S.[3] To better prepare the students at the University of Oklahoma, the Engineering Media Lab has developed a Internet-based review program for the FE that can be used by engineering students who want to prepare for the test. The main web site for this review program is shown in Fig.1. The complete web site is discussed by the Ng and Gramoll in a previous paper[4] and only the test generation system will be presented here. In summary, the online FE review program

covers all topics that are examined using text, graphics, animations, and simulations to actively prepare the user to take the exam.

One of the major parts of FE online tutorial is the exam generator program. This program runs completely on the Internet, and does not require any additional textbooks, notebooks, video player, or CD-ROMs. The exam generator programs are based on the basic engineering concepts, and the form of tests are also similar to the actual exam. This full program is designed for student self-study and instructors to prepare their students as part of their review process.
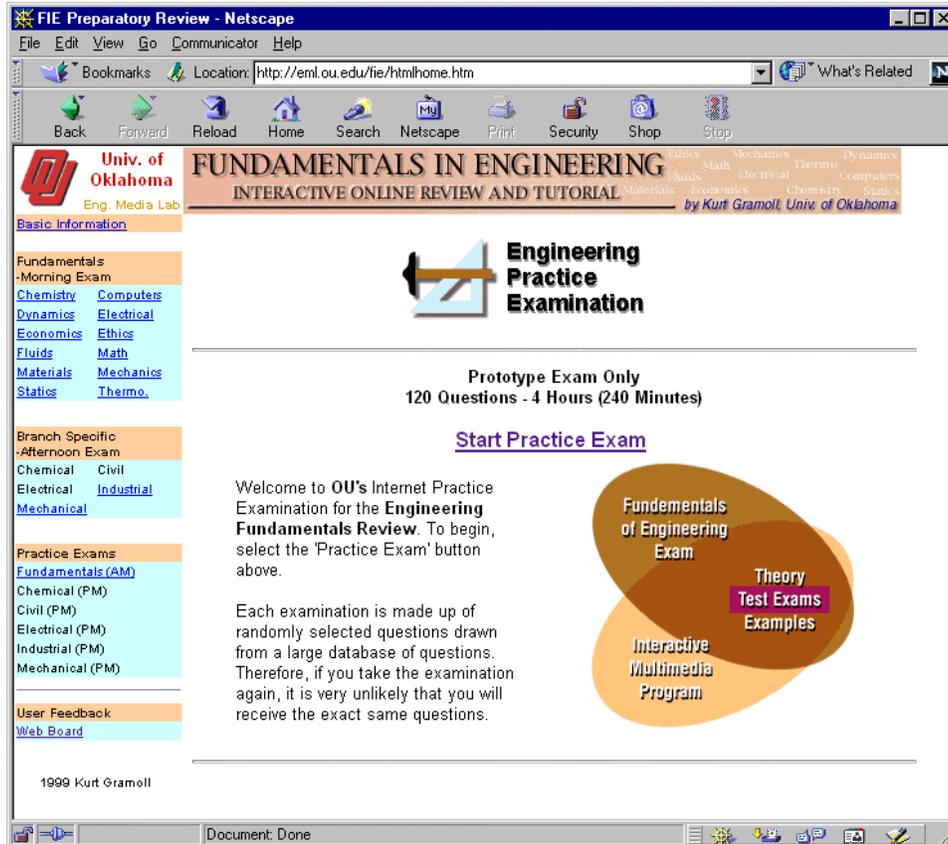

Fig. 1. The first page of FE/EIT on line tutorial

2.1 The Exam Generator

One of the main features of the exam generator program is that it can create a number of different exams. When users access the exam generator through a web browser, the program on the server creates different problems for each user and varies parameters (were feasible) for each of the 120 questions. This data has information about a number of parameters such as correct answers, wrong answers, variables, pictures, and order of exam questions. All parameters are programmed to generate a reasonable range for the variable values and the random order of

problems. The actual exam generation is done by CGI scripts on the web server with Perl programming language. The Flash Generator program on the server imports this data and puts this information into problem templates. The web page uses the Flash Generator templates for creating new exam pages on the browser as shown in Fig. 2.
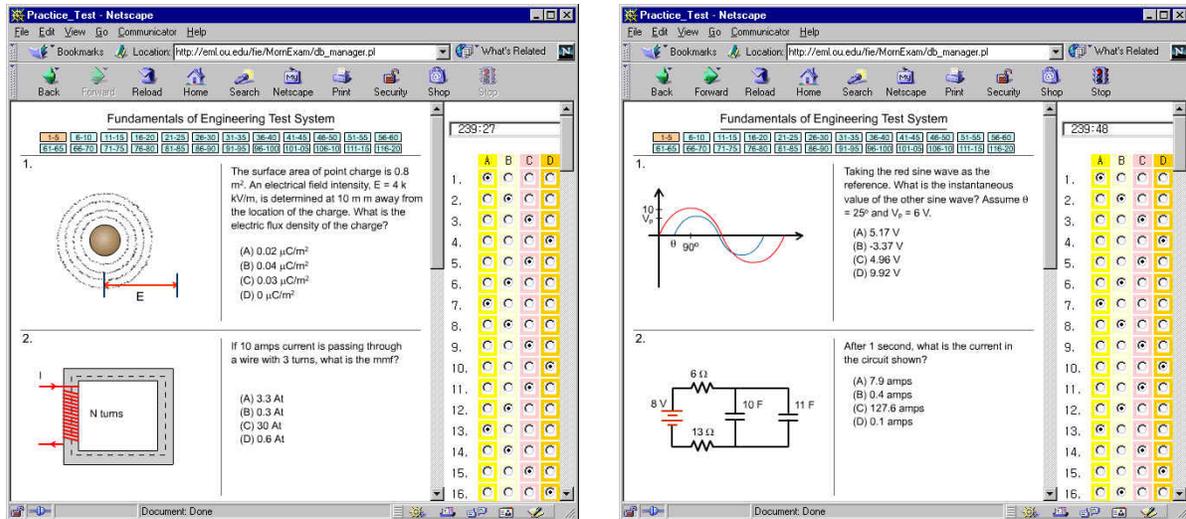

Fig. 2 Two different users see different questions at the same time
while taking the practice exam.

To display the Flash Generator templates, they need to be placed in a standard HTML web page. HTML is a document-layout and hyper link-specification language. All Web pages require HTML code so that the Web page can be rendered by the browser. However HTML can be generated by static web pages, dynamic web pages or CGI scripts on the server.[5] The online exam system uses Perl and JavaScript to generate the basic web page for problems. However, the actual exam problems are constructed using the web server-side program called Flash Generator.

Flash Generator has the unique ability to generate dynamically changing web pages. This program can make templates which can contain text, graphics, and sound. Flash generator can fill the placeholders with content from a data source.[6] The data source can be generated by Perl, JavaScript, C++, or any computer languages which work on Internet. However, to create the base graphic files that are used in the Flash Generate templates, both Freehand and Flash was used. To minimize the file size, the graphics need to stay as vector based drawings and not pixel-based pictures. The Exam Generator is using streaming technology, so it's operation processing and response time is short.

Perl programming language is used to create the Flash generator data source and to make log files. All parameters for each question are randomly generated by using a server-side program written in Perl. When the user accesses the web page, Perl makes a log file for each user, and also checks valid user and ID. Since the exam has 120 problems, the server-side Perl program record and store each problem's variables, answers, and wrong answers so that the same exam

can be viewed later and the some problems will appear. A feedback report is also send to the user using Perl so that they can learn of his or her score immediately.

CHOOSE PARAMETERS

SUBMIT ANSWERS

USER

SERVER

CHOOSES TEMPLTES
GENERATES VARIABLES, & QUESTIONS
MAKES PROBLEM SET

MAKES CORRECT & CHECK ANSWERS
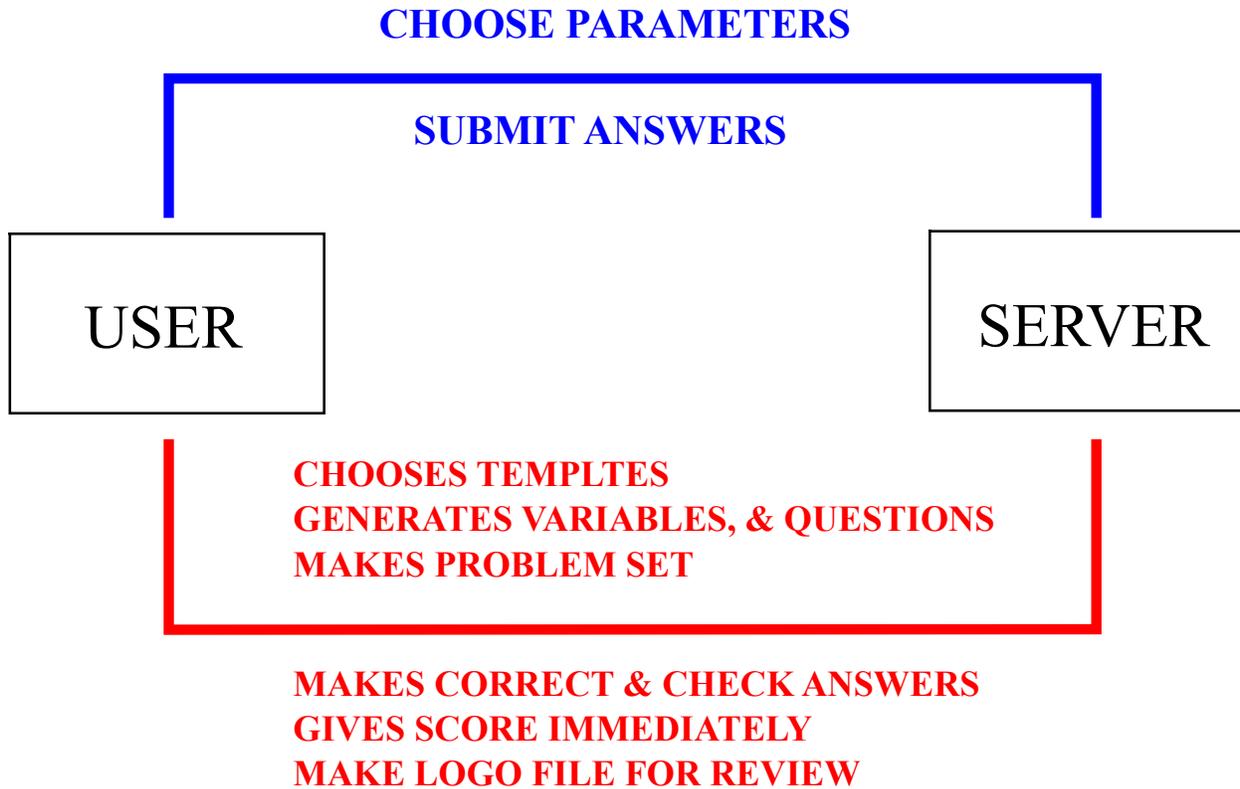**GIVES SCORE IMMEDIATELY**
MAKE LOGO FILE FOR REVIEW

Fig. 3 The Generator Opration

2.2 The Exam Page

The exam page is started by computer's random choice of 120 problems from a database of over 500 templetes. The top portion of the exam web page has problem navigation buttons as shown in Fig. 4. These button allow the user to move to jump between the 24 separate pages, each containing five problems. The exam web page with the 120 problems will take from 20 to 50 seconds to load depending on the network connection. However, because the system uses vector-based graphics and streaming technology, the first 5 to 10 problems can be viewed while the rest of the problems are still being downloaded. The picture size are lower resolution that printed graphics, but are easily seen since pictures have been designed specifically for web page viewing

The time required for exam generation is less than time taken for distributing test papers in a traditional classroom setting. FE test is a time constrained test, hence monitoring the time while

practicing is important to simulate the real test taking. The exam generator sets up a timer which begins when the main testing page loads as shown in Fig. 4. This timer continuously shows the time, and the exam generator submits the test automatically at the end of test time, giving the users feedback of their speed on the test.
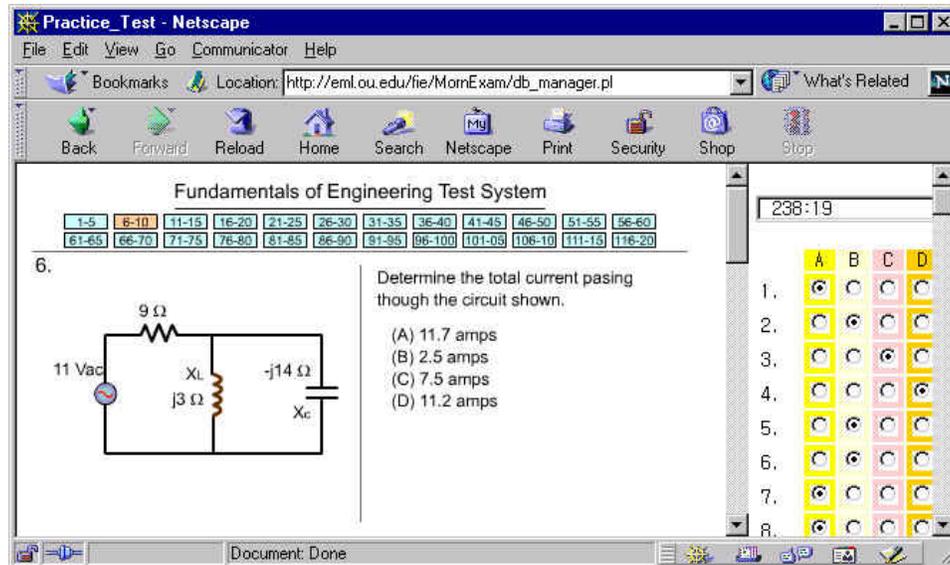

Fig.4 The exam testing page and the timer

2.3 Exam result and score reporting

The scores and answers are available immediately, since the system checks the answers after submission. The right side of testing page shows the results of test. There are test score, user's answers, and correct answers as shown in Fig. 5. After submitting the test, the exam generator generates the exam result, and this result is saved for review or error checking at a later date if the user so desires.
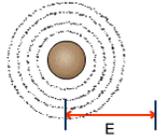
**Fundamentals of Engineering Test System**

1-5 6-10 11-15 16-20 21-25 26-30 31-35 36-40 41-45 46-50 51-55 56-60
61-65 66-70 71-75 76-80 81-85 86-90 91-95 96-100 101-05 106-10 111-15 116-20

1.

The surface area of point charge is 0.3 m². An electrical field intensity, E = 46 k kV/m, is determined at 5 m m away from the location of the charge. What is the electric flux density of the charge?

(A) 0.002 μC/m²
(B) 0.19 μC/m²
(C) 0.25 μC/m²
(D) 0.0012 μC/m²

E

2.

-Q₁   -Q₂
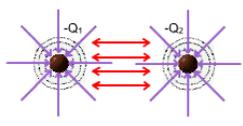
Two point charges, are held 0.7 m apart in free space. Find the repulsion forces between the charges. Assume Q₁ = 26 μC and Q₂ = 21 μC.

(A) 3339.81 N
(B) 7.01 N
(C) 0.07 N
(D) 14.25 N

3.

6 k Ω   Ω   A

28 V   1 k Ω   R_L

B
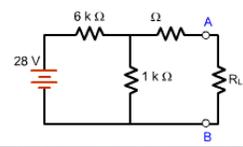
Determine I_N for the circuit within the terminal A and B.

(A) 3.96 amps
(B) 0.04 amps
(C) 0.07 amps
(D) 0.24 amps

Score = 28

Prob	User	Actual	
1	A	C	X
2	B	C	X
3	C	B	X
4	D	C	X
5	C	D	X
6	B	A	X
7	A	A	
8	B	C	X
9	C	A	X
10	C	D	X
11	B	A	X
12	D	D	
13	B	B	
14	C	B	X
15	D	D	
16	B	D	X
17	A	A	
18	C	D	X
19	C	A	X
20	B	A	X
21	A	A	
22	B	D	X
23	C	C	
24	D	B	X
25	C	B	X
26	B	C	X
27	A	C	X
28	C	A	X
29	C	A	X
30	B	C	X
31	B	A	X
32	A	D	X
33	A	B	X
34	B	B	
35	C	D	X
36	D	D	
37	D	B	X
38	C	A	X
39	B	B	
40	A	D	X
41	B	B	
42	C	C	
43	D	D	
44	C	A	X
45	B	D	X
46	A	A	
47	B	D	X
48	C	A	X
49	D	C	X
50	C	D	X
51	B	C	X
52	B	A	X
53	A	C	X
54	A	B	X
55	B	A	X
56	B	A	X
57	C	A	X
58	C	C	
59	D	D	

Document: Done

Fig. 5 The problems, score, correct, and wrong answers

2.4 Log File generation

The exam page is started by logging into the test section of the FE web site as shown in Fig. 6. The main purpose of this page is to check a valid user and make a log file for the user. New user can create account whenever they desire to do so. The exam generator keeps a log file for all the testing and grading, allowing the user to check their previous tests. The exam generator currently only saves up to 10 test reviews as shown Fig. 7. The log file of the review section also helps in error checking such as two same answers given for one particular question.
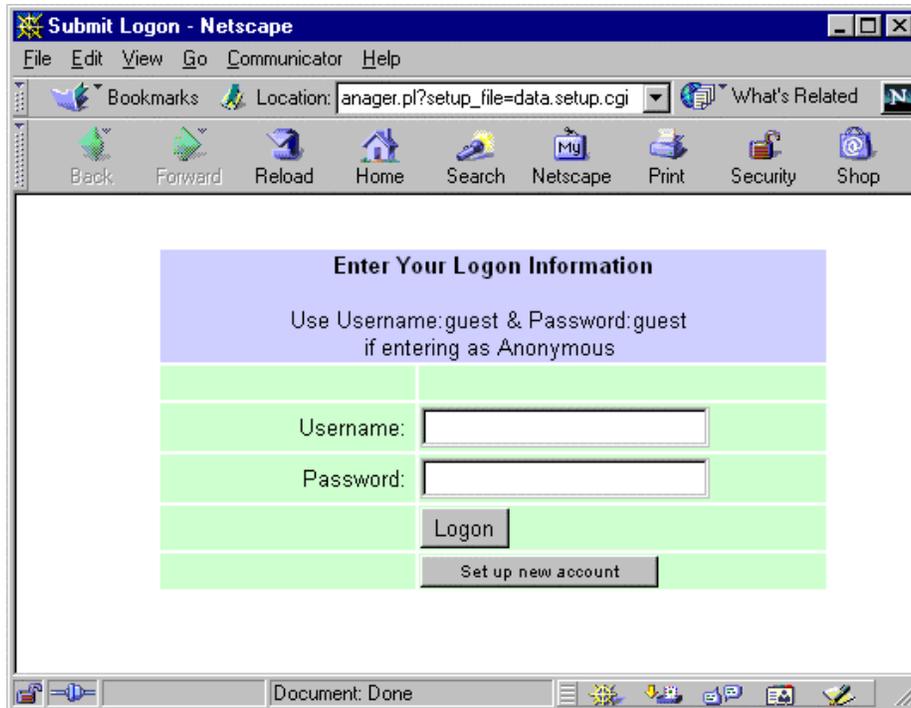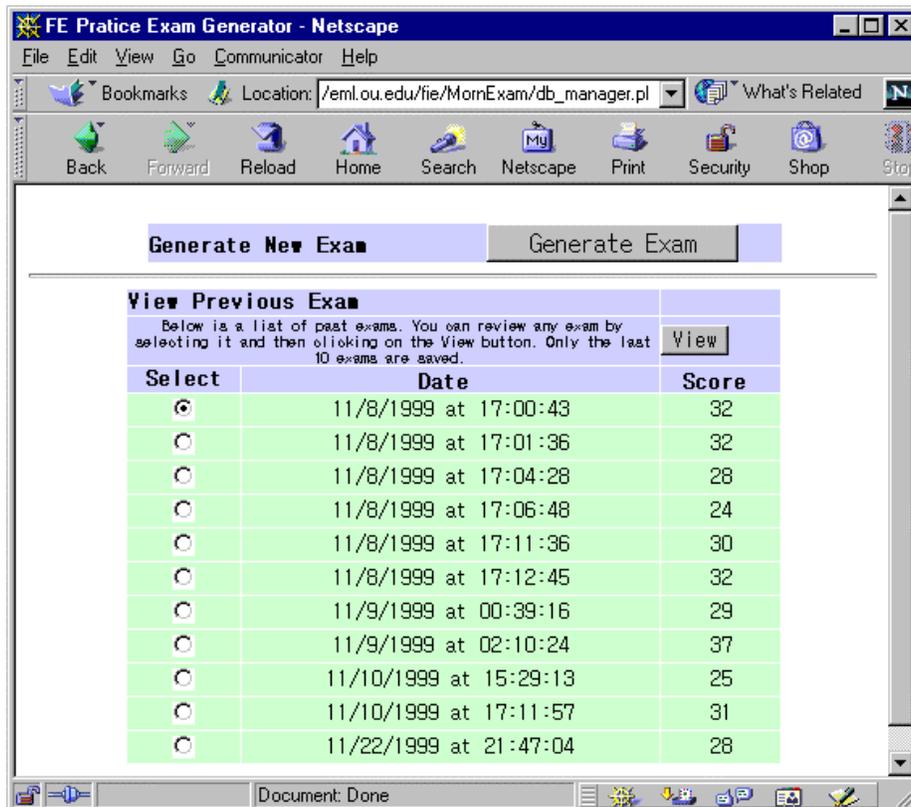
Fig.6 Logon page

Fig.7 Problem review page

III. Conclusion

The Generator program is new paradigm for Engineering student, since it uses the concept of problem generation to prepare students to take the FE exam and to monitor their learning as an undergraduate. The FE exam is one of the important tests for engineering students, so students need a good amount of test problems as well as good reference books having full multiple choice and practice exams for the test. The EML (Engineering Media Lab) at the University of Oklahoma has developed FE/EIT on line tutorial programs that help the students to review for the exam and the exam generator that can generate a lot of tests. The exam generator supports not only problems but also back-end programs that simulate the real test. The contents of the exam problems can be updated and edited constantly to keep up with the every changing requirements of this test.

References

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Biography

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Ji-hoon Lee is currently a graduate student at the University of Oklahoma. He completed his B.S. of Mechanical Engineering in Spring 96 at the Pukyong National University in Korea and continued on with his graduate-level research on multimedia technology for engineering application through fall 99.

KURT GRAMOLL
Kurt Gramoll is the Hughes Centennial Professor of Engineering and Director of the Engineering Media Lab at the University of Oklahoma. He has developed and published CDs and web-based sites for engineering education, K-12 instruction, and training in industry. He has started two multimedia companies for the development and distribution of technical electronic media. Dr. Gramoll received his B.S. degree in Civil engineering and M.S. degree in Mechanical Engineering, both from the University of Utah. He received his Ph.D. in Engineering Science and Mechanics from Virginia Tech. Previously, he has taught at the Univ. of Memphis and Georgia Tech.