The Design and Implementation of a Computer Based Testing System

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Abstract:

Examination is one of the most widely used methods of evaluating knowledge and ability of a student. The use of Information and Communication Technology in administering examinations can improve efficiency and reduce the delay in the notification of a student’s score after examination. A Computer Based Testing System (CBTS) was designed and implemented to reduce the delay in the notification of student’s final examination score as well as other aspects of assessment such as Test and Assignments. The CBTS was developed using the Waterfall Model of a Software Development Life Cycle (SDLC). Implementation was done using open source web-based technologies such as WAMP server, MySQL, PHP, JavaScript, Cascading Style Sheet and Hypertext Markup Language. The CBTS presents a notification of the student’s final score in an examination as well as scores in other forms of assessments. The use of CBTS can improve the efficiency and profitability of academic institutions as it reduces the cost of stationeries and labor involved in conducting examination manually. This work can be improved through the introduction of other forms of questions types such as theory based and diagrammatic questions to make the test questions more diverse.

1. Introduction

An Examination is one of the best methods of evaluating the knowledge and ability of an individual [1]. Its purpose is to assess how much each student has learned compared to fellow students in the same course or learning situation [2]. Various examination methods are being used in higher education institutions to assess academic progress, such as paper-pencil-based examinations, assignments, presentations, etc. These methods are referred to as traditional methods. Traditional Examination refers to a formal examination administered through question papers to which students respond in the form of written answers to a limited choice of previously unseen examination questions, set in advance and answered in examination centers where invigilators (examination supervisors) prevent communication between students and prohibit the use of notes or other revision aids [3].

The inclusion of ICT in education has promoted institutional use of CBTS which is also referred to as Electronic Examination [1], Computer Assisted Testing, Computerized Assessment, Computer Aided Assessment (CAA), Computer Based Assessment (CBA), Online Assessment, Electronic-Assessment (E-assessment) and Web-Based assessment [4].

The use of Examinations for assessment dates back to over a thousand years ago, where it was believed to have been used for the employment and promotion of workers in the Chinese civil service which started during the Han Dynasty in 207 BC. The test included the philosophy of Confucius and other subjects like military, mathematics, geography, poetry and calligraphy [5, 6].

The history of computer-based testing began in the early 1970s with the introduction of the early computers in the 1970s which revealed the potentials of using technology not only for new learning environments but also for completely new settings in the design and administration of tests [7, 8]. E-assessment originated with the PLATO system from the University of Illinois and was commercialized by Control Data Corporation in the 1970s, starting with a computer testing system for National Association of Securities Dealers (now the Financial Industry Regulatory Authority). The testing business grew slowly and is today known as Thomson Prometric. Further expansion of the testing system was occasioned by Pearson VUE in 1994 which was one of the first to use the internet for CBTS [9]. Today many universities and institutions employ the use of computer based testing [10].

The rapid advancement in Information and Communication Technology (ICT) has resulted in a transformation in the way many manually processed activities are being performed today. One of such activities is the assessment of students which has evolved from the use of paper-and-pencil to a computer-based format in recent years [4]. Dietel et al [11] defined assessment as any method used to understand the current knowledge that a student possesses. The concepts of assessment, examination and testing stimulate students to conscientiously study, attend lectures and actively partake in assignments in order to avoid failure as well as ensuring that teachers make a proper planning of their lessons and teach carefully in class [12].

With the growth in the number of students aspiring for western education in Africa, and a limited number of qualified educators, the use of a Computer-Based Testing System (CBTS) provides a solution to meet the challenge [13]. In his Paper “E-Government in Nigeria’s e-Strategy” Ajayi [14], as cited in Ayo et al [15] presented that the Nigeria National Information Technology (IT) policy, which was formulated in the year 2000, is responsible for the monumental developments across the various sectors of the economy. The vision is to make Nigeria an IT capable country in Africa and a key player in the information society. Its primary mission is to use IT for: education; creation of wealth; poverty alleviation; job creation; governance; health; agriculture; etcetera.

Academic institutions all over the world today are recognized for their contributions to the alleviation of societal and environmental challenges through the development of software applications capable of solving problems and performing some basic human operations [9]. These recognitions should act as a catalyst to steer the academia to advanced research topics and problem resolution. Being occupied with the recurrent challenges of performing students’ assessment through examinations and some basic administrative documentation of students’ scores, a distraction to ‘focus’ and a constraint in time availability for research work pose a challenge to research lecturers as some of their experiments, as the case may be, could be time-bound. It suffices therefore that, students’ assessment and its associated mark recording, being integral aspects of any academic system should not be a time-consuming task on educators but be automated to avoid delay in the release of results, reduction in examination malpractices, minimize the cost of printing examination materials and provide minimal human errors [16]. The use of technology is the panacea to these challenges as it has made every aspect of education modern, reliable,
global and efficient and its features are more prominent in the conduct of computer-based examinations world-wide [10].

A user assessment survey on the use of a CBTS, revealed that the setting, conducting and grading of examination as well as generating and managing results become highly time-efficient, less prone to human error, more secured and at the comfort of both the lecturers and the students and so is preferred over the existing ‘open and paper’ platforms for conducting examinations [16]. In the same vein, Rashad et al [13] in a test conducted at the Mansoura University, Egypt, proved the validity of using a CBTS for the evaluation of a large number of students in Egyptian institutions. It therefore implies that a well-structured Computer-Based Testing System could improve the teaching level by providing better technical support [12].

Students in tertiary institutions of Nigeria are primarily assessed based on the use of written examinations. This has resulted in the common recurrence that the results for these examinations are delayed and even in some cases, not released especially where there are large classes or public examinations [10]. This is undesirable to the Nigerian students who will be unable to immediately track academic grades at the end of each semester. This problem could be due to the delay in the marking of the students’ answer sheets, loss of answer sheets and even in some cases scrawny practices by some lecturers in the manipulation of the scores of the students. With the use of this CBTS, the challenge of a delayed notification of a student total score after final examination on a particular course will be reduced. The system will manage different aspects of the student’s assessment which include test, attendance, assignments, mid-semester and final examination. This work focuses on the roles of the student, the lecturer and the system administrator in ensuring that the CBTS provides a timely and dependable system for students’ assessment and faculty members’ use in educational institutions such as secondary and tertiary schools as well as professional training centers. The question types are multiple choice questions and the software will be limited to a single department or course of study. The objectives of this work are to:

1. Design a System showing the functional relationship between the student, the lecturer and the system administrator in a CBTS.
2. Develop a CBTS that manages students’ final examination, while taking into cognizance other aspects of assessment such as test, mid-semester examination, assignments and attendance for lectures.

2. Literature Review

2.1. Overview of Computer Based Testing System (CBTS)

2.1.1. Features of a CBTS

A CBTS is a form of assessment in which the computer is an integral part of question papers’ delivery, response storage, marking of response or reporting of results from a test or exercise [17]. It can be a multiple choice question based examination system that provides an easy to use environment for both Test Conductors and Students appearing for Examination. The main objective of a CBTS is to provide all the features that an Examination System must have, with the interfaces that do not scare its users [18]. According to Taylor [19] as cited in Newhouse [20], a Computer-Based Testing could be delivered on a stand-alone personal computer, within an isolated Local Area Network (LAN) or through the use of online technologies such as web-pages over the Internet. The two types of CBTS are:

1. Linear Test - This involves a full-length examination in which the computer selects different questions for individuals without considering their performance level.
2. Adaptive Test - Here the computer selects the range of questions based on individuals’ performance level. These questions are taken from a very large pool of possible questions categorized by content and difficulty [21].

2.1.2. Effectiveness of a CBTS

The effectiveness of a computer based testing system depends largely on factors such as standardization, security, examination conditions, mode of administering the examination, cost and so on. Some of these factors have been identified in literature as follow:

1. A CBTS is cost effective especially when deployed in the conduct of a mass-driven examination as there will be no need to print questions or answer booklets [16].
2. Adewale et al [22] inferred that human errors can be eliminated and examination malpractice eradicated when a CBTS is adopted in the process of examination. In the same vein, Akunyili [23] in her presentation in Amsterdam on ‘ICT and E-government’ stated that manually marked scripts were more prone to errors than computer marked ones.
3. In their system design, Adebayo [1] stated that security will be more effective since the system includes biometric fingerprint authentication, picture capture and data encryption and decryption.
4. Al-Amri [24] also stated that the standardization of test administration conditions is one of the benefits offered by CBTS. No matter the size of the test-takers, CBTS helps test developers to set the same test conditions for all participants.
5. Bodmann [25] in their study investigated the effect of several different modes of test administration on scores and completion times. They observed that undergraduate students completed the computer-based assessment test faster than the paper-based assessment test.
6. Jamila et al [4] presented that technology based assessment provide opportunities to measure complex form of knowledge and reasoning that is not possible to engage and assess through traditional methods.
7. Osang [26] in his study of electronic examination in Nigeria, suggested that course coordinators prefer electronic examination to pen and paper examinations as it requires lesser administrative tasks for the coordinators and enhances a timely release of examination result.

2.1.3. Applications of CBTS in Nigeria

Online examinations which are a variant of a CBTS can be used as an assessment-evaluation tool in distance education systems that have a quite a number of students. For such systems, good execution of examination aims of assessment and evaluation is very critical because problems arising from human-centered errors or technical difficulties may lead to questioning of the examination, and thus reliability and efficiency of the distance education systems Taşcı et al [27].

Resuscitated in 2002 by President Olusegun Obasanjo, National Open University of Nigeria (NOUN) (a distance learning institution) which currently has not less than seven schools and academic centers employs the use of electronic examination in the evaluation phase of students study circle. Research studied on 105 academic staff revealed that 84 respondents recommended CBTS for conducting examination in NOUN based on the fact that it was easy to administer and used by the students. Most especially is the fact that, the result of the examination can be viewed almost immediately after the examination Osang [26].

Tertiary institutions in Nigeria now use CBTS in the Post Unified Tertiary and Matriculation Examination (Post-UTME) for screening their students. Also, some Nigerian universities are almost fully or partially implementing the CBTS for assessing their students. These include:
1. National Open University of Nigeria (NOUN)
2. University of Ilorin, Ilorin
3. Federal University of Technology, Minna
4. Covenant University, Ota (Private)
5. University of Nigeria, Nsukka
6. University of Lagos, Lagos

However, NOUN is the only Nigerian University that is fully implementing CBTS for assessing her students and this is employed through the internet. Other universities employ the use of the Intranet [10]. Furthermore, the Joint Admissions and Matriculation Board (JAMB) which is the national matriculation examination body for admissions into Nigerian higher institutions of learning has adopted the use of a CBTS for the conduct of its examination. The revolutionary dimensions of this ICT-enhanced service can only be appreciated when compared with the former system where the examination results were anxiously awaited by the candidates for close to eight weeks as against seven working days with the use of a CBTS [23].

2.2. Related Works

Zhenning et al [28] developed a novel online examination system based on a Browser/Server framework which carries out automatic grading of objective questions for basic computer operating skills. The courses included Visual Basic programming, Microsoft Windows operating system, Word, Excel and PowerPoint editing, Internet and Email skills. The system was a distributed collaborative system which was based on a Distributed Component Object Model (DCOM) technology. Internet Information Server 4.0 (IIS) was used as the Web Server, Microsoft SQL Server 7.0 as Database Server and a user friendly browser as the client’s interface. Cryptography, real-time monitoring system and data transmission encryption were used to guarantee security of the system. The system can be improved on through a random administration of questions to reduce the level of examination malpractice.

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A web-based online examination system that is not limited by time and place was developed by Yuan-Lung et al. [29] to enable students arrange their time for examination in accordance with the progress of their lessons. The system had simple fraud protection function by employing a random generation in the order of questions in each student’s test, making cheating extremely difficult. The questions could also be in diagram form, animations and other multimedia forms other than textual test questions, therefore making the test questions more diverse. Teachers can make statistical analysis aimed at a particular test to determine the average mark scored by students on a particular test, and this can be used as a reference material for teaching remediation. The design was broadly structured into three areas: the student area, the teacher area and others (includes administrator, production group and comments). Implementation was done using Windows 2000 as the operating system. ASP (Active Server Pages) was used to provide a dynamic web page while the functions required by the online examination system were appropriately processed through the VB (Visual Basic) Script in ASP. The system also used the IIS technology (Internet information Server) to construct an ASP platform while Microsoft Access functioned as the database. The database was accessed using ODBC. Users can arrange their examination time in accordance with the progress of their lessons. Test takers can check the test solutions immediately after the test, thus letting students know their mistakes and work on them. Correct answers help prevent the rise in cybercrime. The timing feature of the online examination system should be looked into in order to ensure that the questions for students’ assessment are not tampered with or leaked prior to formal examination date.

Rashad et al. [13] developed an examination management system that is capable of supporting an institution’s faculty, student and administration roles in the examination process. It employs different kinds of questions such as yes/no questions, multiple choice/single answer questions, multiple choice/multiple answer questions, fill-in-the-gap questions with a string, numeric answer and essay questions. Examinations are automatically marked on conclusion of the answers and reports for the test are produced. It can be used via the Internet and is therefore suitable for both local and remote examination. The system could help lecturers, instructors, teachers and others who are willing to create new examinations or edit existing ones as well as students participating in the examination. The system was built using various open source technologies AJAX, PHP, HTML and MYSQL database. The system would require a more reliable form of security since it can be used via the internet.

Quao-fang [12] developed a self-test online examination system that enables students to randomly select a test paper or use a test question designated by the teacher to test them in order to understand their learning level and adjust their learning progress. The system allows the teacher to manage questions through querying, adding, deleting and modifying the questions. It also ensures that test questions are randomly generated according to specified requirements. A student can also randomly select a paper for self-test. Implementation was done using a Browser/Server model (a special kind of client/server model) as its network application development model. Java Web technologies using JSP Model 1 and JavaBean were used together with Tomcat (open source software) as the JSP Engine and Web Server. JavaScript was used on the client-side scripting language while JSP was used as the server-side scripting language. The system provides online testing capability for students anytime they want to test their level of understanding of a course. Also a combination of client-side programming and server-side programming techniques were used and analyzed in the research. However this work does not inform us whether the system had a timing feature that logs off the student from the system when his time is up; this will assist in assessing how well the student has mastered a particular course.

Indoria et al. [30] developed a web-based online examination system that generates student’s scores on submission of the examination. The Administrator of the system had the privilege of creating, modifying and deleting the test papers. A user can register and login with his/her specific id. The system was structured into two areas which are the administrator area and the operator area (user). System development was achieved using ASP.NET and VB.NET having DB2 as back end (database). Windows 2000 Enterprise was used for the server interface while either of Windows 95/98/2000/NT could be used for the client interface. The system can generate students report based on the ‘list of passed students’, ‘list of students pass with merit’ and ‘list of failed students’. The limitation of this system is that the teacher cannot enter the questions directly into the system and the questions cannot be generated randomly.

The CBT system developed by Fagbola et al. [16] was an online examination system that assesses students using multiple choice questions set by the lecturers and is capable of grading students accordingly. The system is expected to provide an effective solution for mass student evaluation and provides functionalities such as auto-submission of examination on expiration of set time, auto-grading of students and examination result report generation. The Waterfall Model of software development Life cycle was adopted and the conceptual design (activity diagram, the use cases, the data flow diagram and the entity-relationship diagram) were presented. Macromedia Dreamweaver 8.0, Microsoft Visual Studio 2012 and Microsoft SQL Server 2008 were the tools used for the development of the CBT system. The system was implemented using C# (C Sharp) and SQL server. The CBT system was composed of six different functional pages which are the student login page, the admin login page, the result summary page, the question page, question upload and configuration page and the student result page. It was expected that the system would proffer solutions to challenges such as examination malpractices, low capacity examination venues, inadequate invigilators and inadequate examination materials. Performance assessment of the CBT system was carried out using 250 students and the statistics proved the system as highly flexible. This CBT system can be improved on through the implementation of essay-based questions. Security and sensitivity of students’ continuous assessment should also be included for it to be effective in a tertiary institution.

Taşci et al. [27] proposed an online examination system architecture which provides for integrated management of an examination main functionalities. These include question pool creation and update, examination authoring, execution and evaluation, management of the feedbacks from students, along with ensuring use of analysis reports related to the questions and examination created by an intelligent agent in the decision-making processes. The system architecture includes Administration, Implementation, Finalization and Support layer. A Monitoring Agent was designed to help students through creating reports. Analyses on this system at Sakarya University Turkey, showed that the proposed intelligent agent supports online examination system, detects problems that may arise and enables the instructors to make decisions more easily on such problems in a shorter time. The expert system which uses the IF THEN construct is expected to expand to include additional intelligent features with the aim of resolving different problems.

The use of ICT in the assessment of students has evolved over time and will continue to advance due to its effectiveness [31]. Earlier works on CBT Systems have been towards the recording and notification of the student’s final examination score. However, this work, in addition to the notification of the student’s final score, also presents the student’s scores in other forms of assessment. These forms of academic assessment were based on the Nigerian structure of higher institutional examination systems. The Software Development Life Cycle (SDLC) for this system is the Waterfall Model. The CBTs design was presented using: use case diagrams, architectural diagram, entity-relationship diagram and data flow diagram. The design was based on the users and system requirements of the CBTS.

3. System Analysis and Design

The CBTS developed in this work is based on the existing implementation infrastructures with an improvement in the systems adaptability to meet with the Nigerian structure of higher institutional examination systems. The Software Development Life Cycle (SDLC) for this system is the Waterfall Model. The CBTS design was presented using: use case diagrams, architectural diagram, entity-relationship diagram and data flow diagram. The design was based on the users and system requirements of the CBTS.

3.1. CBTS Development Life Cycle

The Waterfall model is a traditional SDLC introduced and popularized in the 1970s. The model has been reported to have achieved great success on many large projects of the past [32]. This model was adopted for the development of the CBTS since it ensures the developers and users were working with the same software where the requirements specification of the software is well understood. The requirements of CBTS were well-defined and so could easily be monitored during development using the waterfall model. Pressman [33] stated that “a process model for software engineering is chosen based on the nature of the project and application, the methods and tools to be used, and the controls and deliverables that are required.” The waterfall model which suggests a systematic, sequential approach to
software development that begins at the system level and progresses through analysis, design, coding, testing, and support is adopted in this work. It is a classic process model which is widely known, understood and used. It has been tested and proven over the years as a reliable model for designing systematic project. In some respect, it is called the “common sense” approach. Among its numerous advantages is the fact that it is easy to understand and implement, document driven, works well on large/mature and weak teams and it also fits other engineering process models.

Using the waterfall model, the CBTS SDLC was split up into a number of independent steps as shown in Figure 1. These steps were carried out in sequence one after the other. Each stage produces a product which is the input into the next stage. Each stage is pursued until its conclusion before the next stage is begun [34]. The phases involved in the CBTS SDLC are:

- Requirements Analysis and Definition
- System and Software Design
- Implementation and Unit testing
- Integration and System testing
- Operation and Maintenance

![Figure 1: Waterfall Model for the CBTS DLC [35]](image)

### 3.1.1. Requirements Analysis and Definition

Requirements analysis and definition involves the writing of a clear statement, often in natural language, of what the system is expected to provide for its users. This information is called the requirements specification [34]. Requirements elicitation were derived from interaction with students and lecturers of Babcock University and also from literature review of other related works.

User and System requirements - This describes the end-users requirements for the system. The users of this system are the students, the lecturers and an administrator. The Use Case Diagrams (informal graphical representation of requirements) show the user requirements and a more detailed system requirements (specific functions to be carried out by the system) for the CBTS system are also presented.

A) The Student

Figure 2 shows the Student’s Use case diagram indicating that student shall be able to:

1. Log in to the system
2. Take either an examination and
3. View scores at the end of the assessment.

![Figure 2: Use Case Diagram for the Student](image)

B) The Lecturer

Figure 3 shows the use case diagram for the lecturer indicating that lecturer shall be able to:

1. Log on to the system
2. Register student in the system
3. Set examination questions and instructions
4. Insert options to questions in the database

![Figure 3: Use Case Diagram for the Lecturer](image)

### Functional requirements of the CBTS

- **Functional requirements** refer to the statements of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situations [35]. The CBTS should be able to:
  1. Authenticate both student and lecturer’s log in details
  2. Create sessions for each student
  3. Restrict the student to make only one selection of the options to the questions
  4. Allow the student to go back to review or modify already answered questions
  5. Generate questions randomly
  6. Prevent repetition of questions already generated
  7. Calculate student’s score at the end of the examination

**Non-functional Requirements for the CBTS** - These are the requirements that specify the criteria that can be used to judge the operation of a system, rather than specific behaviors [36]. The CBTS should:

1. Possess low response time and increased speed in executing user request
2. Be reliable, that is, should guarantee minimal rate of failure occurrence
3. Be user friendly, that is, the user interface should be easy to use
4. Be scalable, that is, should not collapse with additional resources or users
5. Possess a large memory size
6. Be maintainable

### 3.2. System Design

The CBTS was designed based on the requirements specification. The architectural design together with the Entity-Relationship Diagram and Data flow diagram are presented in Figures 5, 6 and 7.

### 3.3. Development Tools

The CBTS was developed using WAMP Server, Hypertext Markup Language (HTML), JavaScript and Cascading Style Sheet (CSS), PHP and MySQL.

### 4. System Implementation and Testing

This section presents the implementation of the different modules of the CBTS and the testing of these modules to ensure that they function in accordance with the CBTS requirements.

#### 4.1. Unit and Integration Testing

The different modules (units), integrated system, as well as the system database were tested to ensure that the system is completely free from errors.
While unit testing involves testing the individual components that make up the system, integration testing is mainly concerned with finding defects in the entire system. The database which is made up of a collection of logically related tables was also tested to ensure that the set of rules and constraints guiding the type of data stored in the tables are not violated.

4.2. CBTS Modules

The CBTS is composed of the four major modules as follows:

1. The Index Page - This is the first Page that appears when the CBTS is launched from the web browser as shown in Figure 8 in the Appendix. It provides navigation to the other modules of the CBTS such as the administrator interface, the lecturers interface and the students interface.

2. Administrator Module - Access to this page is restricted to an administrator whose log in details (username and password) is authenticated by the CBTS. Upon successful log on, he can change his password via the change password menu. The registration of lecturers, generation of student score, creation of student class and the review of student responses to the questions are the functions which the administrator can perform via a successful logon through this interface. This process is presented in Figures 9, 10, 11, and 12 in the Appendix.

3. Lecturer’s Module - The CBTS grants access to a registered lecturer upon validation of the lecturer’s login details. The Lecturer can upload questions and instructions into the CBTS, register student for a test and view student score via the access links on his/her log in page as shown in Figures 13, 14, 15 and 16 in the Appendix.

4. Student Module - A registered student for a test can logon to the system via this module. The student enters his username and the password assigned to him/her by the lecturer. Upon successful logon to the system the first question together with its instruction is generated. The Examination timer is activated and the student is automatically logged off the CBTS upon expiration of the timer or submission of the completed test by the student. The CBTS automatically generates the students score for that particular course upon submission. This is shown in Figures 17, 18 and 19 in the Appendix.

5. Conclusion and Recommendation for Further Works

In an evolving and technologically-developing world such as Nigeria, where there is a dearth of lecturers who are saddled with much responsibilities than they can handle, the need for a CBTS that can take up some of their routinely but relevant task cannot be overemphasized. This work was aimed at designing and implementing a CBTS that prevents the delay in the notification of a student’s final course score, take off the burden of marking examination papers and also eases the preparation of examination questions through the re-use of questions from the question bank of the CBTS. From the outcome of this work, it can be said that the use of a CBTS can promote academic efficiency through a timely notification of students’ performance with reduced man-hour expenditure from the lecturer. Academic institutions should explore the vast opportunities provided by ICT in the educational system especially as it concerns student assessment. The benefits of a CBTS such as; reduced cost of implementation through the use of open source technologies, reduction in the use of stationeries for test administration, reduced time and labor could enhance the profitability of an academic institution.

This System can be adopted for use in either a secondary or tertiary institution for the administration of examinations ranging from a small to large number of students and also for managing their cumulative assessments. Lecturers should be encouraged to structure the questions to appropriately assess a student's knowledge of the course work since the CBTS uses multiple choice based questions. This work can be improved on as follows:

1. Introduction of other forms of question types such as theory based questions and diagrammatic questions to make the test questions more diverse.
2. Enhancement of the security of the system so that students can take examinations online at a specified time.
3. Inclusion of course materials so that these can be assessed by the student online.

Automatic delivering of the students’ login details to their mobile phones or email address.

Figure 5: Architecture of CBTS

Figure 6: Entity-Relationship Diagram (ERD) for the CBTS

Figure 7: Data Flow diagram for the CBTS
References


Appendix

Figure 8: Index Page
Figure 9: Administrator Login Page
Figure 10: Administrator Welcome Page
Figure 11: Lecturer Registration Page


Figure 12: Class Creation Page

Figure 13: Lecturer Welcome Page

Figure 14: Student Registration Page

Figure 15: Question Insertion Page

Figure 16: Successful addition of Question

Figure 17: Student Examination Login Page

Figure 18: Display of Examination Question

Figure 19: Result Notification Screen