

METU
SOFTWARE DEVELOPMENT STUDIO
SE 560

Analysis Report
“Test Management System”

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1. Introduction

1.1. *Project Definition:*

Our project is the design and implementation of a web-based application to prepare, serve and apply exams and surveys to a group of people. The system may be thought of as a combination of two different software systems, one part used for exam related activities and the other one for managing surveys. This software will provide infrastructure for creating, editing, checking and evaluating multiple-choice exams and surveys based on a question pool. Since our software is web based, it can target a broad market segment which can be a choice from instructors to survey creators.

1.2. *Goals and Scope*

Our aim is to develop a system that will satisfy a set of some minimal requirements that are crucial to have a properly usable system. Along with this, beneficial features of software that are similar to the system we are developing are considered and some of them will also be implemented in our system as constraints permit.

In spite of these the overall project scope is as follows:

- TMS (Test Management System) will allow appropriate users to create or modify new questions which can be defined as public or private with text and/or images. For exam questions answers can also be defined. Private questions can only be accessed by their creators while public ones are going to be open for everyone.
- New tests (exam or questionnaire) can be defined from the existing questions/tests of the user or public questions/tests of the other users.
- Participants can answer the tests and the results can be observed by the participants and the owner of the test.

Main goals of the TMS are:

- Usability: System should be usable for all type of users and it should have shortcuts and easy links.
- Robustness: The system should be reliable enough in order not to bring out unexpected errors during its operation.
- Performance: System should be fast and run accurate enough to be usable.
- Interface: System should consist of interfaces having a simple design to support user friendliness.
- Collaborative working environment: TMS will support many users in same time so that the system should be able to deal with this by providing a suitable authentication mechanism for different groups of users.

1.3. Constraints

Project Schedule

We have to finish the project until end of December 2006 so this is one of the main constraints. We have to design, build and test the project during this period.

Language constraints

We are going to implement our project in Java.

Data constraints

The questions and other data stored in the system may require huge amount of storage and processing as the system becomes to be used by many users with the addition of large number of questions and tests to the system.

Network Bandwidth Usage constraints

Since our system will be web based its user interface should be designed in such a simple way in order not to consume too much network resources. Also other parts of the system should be designed with this consideration.

User Interface constraints

User friendly menus will be created. Easy to use and simple menus will be taken into consideration.

2. Market Research

2.1. Current Systems and their Features Search

Most of the systems do not carry out exam management and survey generation functionalities in one software package. Mostly there are separate software for constructing tests and creating surveys so we examined them under three headings or categories; the last category reflecting the exact functionality of the system we will develop; as follows:

2.2. Exam management or Test Construction Software

A) Keepsoft

Upon our research in this area, one of the most similar and useful software for our purposes is named "Test Constructor" by Keepsoft company.

The overall features and description of this software are as follows:

"Test constructor" is a universal program for testing the knowledge. The program can be used to perform testing both at home and various educational institutions. The program allows using an unlimited number of topics, questions and answers. "Test constructor" supports five types of questions, which gives you an opportunity to perform any kinds of tests. It is possible to use music, sounds, images and video clips in your tests. Any data can be printed out or exported into the files of various formats (Word, Excel, Access, HTML, XML, TXT, Paradox, DBase etc.).

A number of people can be independently tested on one computer, using their own names to enter the program.

"Test constructor" consists of two parts:

1. "Test constructor. The editor" is used to fill in and edit the database, as well as to adjust various "Test constructor" settings.
2. "Test constructor. The trainer" is used to perform the tests based on the topics and questions that have been entered in the database with the help of "The editor".

When we examined this software more deeply by using a demo of it, we found out that it satisfies the minimal set of requirements for such a system. Moreover, it helped us to bring out some further requirements some of which can be considered as expected while the rest as exciting. We found its user interface appropriately designed and easy to use, in accordance with our goals. Some parts of it are very similar to what we have visualized about such a system in our minds. As a consequence, this tool will be useful for us while making some design decisions.

B) Markosoft

This software is for creating exams named "Markosoft Test Creator and Test Taker" which has the following overall description and features:

Markosoft's Test Creator and Test Taker application is designed for teachers which can be used in creating and grading tests. With the Test Creator, users can build tests that include multiple choice, true/false, short answer, and essay questions and the tests can either be printed out in paper format or fully automated and administered using the Test Taker application.

To benefit from fully computerized test administration and grading, first create a class and add all of your students to the class. Then, create some tests and add the tests to the class. Finally, your students can use the Test Taker application and log into the class using the user name and password that you set up for them.

As can be seen from the above features and upon our use of a demo of this software, we found out that this tool adds on some features to the ones provided by "Test constructor" examined above. Its main feature is that it provides a connection between exams, classes and students.

2.3. Survey Software

A) The Survey System

This software has functionalities related to all kinds of surveys but for our purposes, we are only interested in with its Web/Internet Surveys part.

The overall features and description of this software are as follows:

There are two ways to do online surveys using the Web/Internet or an intranet: e-mail and Web page. When using e-mail surveys you send a survey to a list of respondents, and then they reply with their answers. When using Web page surveys, you post your questionnaire on a Web page. People then visit that page and answer your questions. The Survey System's Internet Module includes both types of surveys; namely the Email and Web page surveys.

As part of a comprehensive survey software solution, The Survey System's Web page questionnaires offer sophisticated questionnaire logic features not found in most "Web survey" packages. These features mean higher quality data. After you collect your data, you can produce tables, charts and text reports. You can even produce reports online.

Another benefit of this solution is that you enter your question and answer choice text and any logic instructions only once. Then you can use them for Web page surveys, email surveys, paper questionnaires and telephone interviews.

As a result of our examination of this software, we have seen that it carries out the survey management task perfectly by providing lots of features, some of which we did not think about before. This is partly due to the fact that this tool is specialized only in the survey business. So it is apparent that this tool will be very useful for discovering expected and exciting requirements especially for the survey part of our system.

2.4. Exam and Survey Software

A) Articulate

Upon our research in this area, one of the most similar and useful software for our purposes is named "Articulate Quizmaker" by Articulate company.

The overall features and description of this software are as follows:

Articulate Quizmaker is a comprehensive yet easy-to-use quiz creator for making highly customized Flash-based quizzes, assessments and surveys without the need for difficult programming.

It can be used to create a quiz with different question types. The questions can be chosen from 21 different graded and survey question types – including true/false, multiple choice, fill in the blank, matching, hotspot, Likert scale etc.

With Quizmaker 2 you can:

Incorporate images and Flash movies to add interest and clarity to questions.

Provide feedback (or not) based on quiz-takers' responses.

Display results and specify actions that quiz takers follow based on their scores.

Customize buttons and labels with your choice of text and language.

Brand your quizzes with custom colors and sounds.

Capture quiz results through e-mail, your LMS, Articulate Online or Articulate Knowledge Portal™.

As can be seen from the above features and upon our use of a demo of this software, we found out that it will be mostly useful for us in bringing out exciting requirements. This sophisticated tool has a very nice user interface making the software easy to use. Its main feature is that it can generate Flash-based quizzes which make them to be highly portable.

3. Requirements

3.1. *Functional Requirements*

In this section, requirements of the system will be explained in detail to make it clear what the functionalities of the system are. They will be categorized under three headings: minimum, expected and exciting requirements denoted by (*), (**) and (***) ; respectively.

General

The general requirements of the system are given below:

- Tests, questions and answers can be imported/exported into the files of various formats. (MS Excel, MS Word, Text file, HTML, XML, RTF (Rich Text format), PDF (Adobe Acrobat) etc.) (***)
- Tests, questions, answers and their statistics can be printed. (***)
- Each user can become a member of the system by filling in and submitting a login form. (*)
- Each user is authenticated by a username/password assigned to them which defines their permissions in the system. (*)
- Users can manage their accounts. (They can change their account information (*) along with some parameters such as number questions displayed per page (**), exam screen appearance and layout properties (***))
- Users can belong to one or more user groups. (***)
- Users can log out of the system. (*)

User Groups

- All users belong to one or more user groups. (***)
- If a new group has to be opened, an e-mail is sent to the system administrator which contains a form including:
 - The name of the new group
 - The reason of opening a new group

Then when the group is opened a reply is sent to the requester of this operation. (***)

Note: The user group management operations are not described in detail here and only the open a new group operation is defined (the modify/delete operations are ignored.) since our scope is limited to a test management system. Those operations may take place in Learning Management Systems which have a wider scope.

Categories

- All questions are categorized in three levels. The first category determines whether a question is an exam or a survey question. The second one denotes the subject that the question belongs to and in the third one the sub category or subject for each question is determined. (*)
- If the category of a question has to be changed (**), an e-mail is sent to the system administrator which contains a form including(*):
 - The name of the changed category
 - Explanation of the reason of the change operation

- Then an e-mail message should be sent to the related people based on whether the question whose category is changed is public or private. (***)
- If a new second or third level category has to be opened, an e-mail is sent to the system administrator which contains a form including (*):
 - The name of that category
 - Explanation of the reason of opening a new category
 Then when the category is opened a reply is sent to the requester of this operation. (***)
 - If an existing second or third level category has to be renamed (*), an e-mail is sent to the system administrator which contains a form including (*):
 - The new name of that category
 - Explaining the reason of the rename operation
 Then when the category is renamed a reply is sent to the requester of this operation and other related people. (***)
 - The open new category and rename existing one operations are completed successfully only if the name of the new category or the renamed version of the name is distinct from the name of all other category entries. (*)
 - If an existing second or third level category has to be deleted (*), an e-mail is sent to the system administrator which contains a form including (*):
 - Explaining the reason of the delete operation
 - Indication the category to which the questions of the deleted category will be moved before the delete operation
 - Indication of whether the questions in that category will be deleted.

Then the system checks whether there are questions in that category or not. If that category is not empty and the questions are not to be deleted, the questions in it have to be moved to the preferred category. For the delete case, the questions in the deleted category have to be checked to find out whether they are used in any test or not. If they are not used elsewhere the delete operation can be performed. Afterwards, when the category is deleted a reply is sent to the requester of this operation and other related people. (***)

- An existing second or third level category can be renamed or deleted. (*)

Question

- Each question should belong to a category. (*)
- Each question can be defined as either public or private. Public questions can be accessed by everyone while the private ones can only be accessed by their creators. (*)
- Each question can be consisted of text or images. (*) Also they may contain music, sounds and video clips. (***)
- To create a question, firstly its title should be entered and then its body is created. (*)
- Each exam question can have an answer. (*)
- Each question should have a question type. For exam questions the type can only be multiple-choice questions having only one correct answer. For survey questions various types can be selected such as multiple-choice questions having several correct answers, arrangement questions in which the answers are arranged in a desired sequence, questions in which some items are corresponded to others etc. (*)
- Each exam question should have a difficulty level on a defined scale. (**)
- A question can be modified or deleted if it is not used in any survey or exam. (*)

Exam

- Each exam should have a certain number of questions. (*)
- For each exam it is determined whether it is public or private. (*)
- To create a new exam, firstly a search should be performed on the questions/exams in the system. After the search is completed, the user can select certain questions among them to be used in the exam. Certain exams can also be modified to be used as a new exam. (*)
- The search operation mentioned above can only take place among the public questions/exams in the system (*) and also the private questions/exams that are created by the user who is creating the exam. (**)
- Each exam can have a certain time period during which it will be available. (**)
- For each exam a time limit can be defined denoting the maximum duration for the exam to be completed. (**)
- For each exam, the people who are eligible to take the exam are added to a list one by one (*) or a user-group can be added (***). Also an e-mail message can be sent to the people in that list. (***)
- While taking an exam, it will be possible to navigate among the questions(**)
- The exam is finished if the time is over (**) or the user submits the answers (*).
- At the end of the exam, the users can see their scores along with the correct answers. (*)
- An exam can be deleted or modified (by adding or removing questions to it) if it is not submitted by anyone. (*)

Survey

- Each survey should have a certain number of questions. (*)
- For survey it is determined whether it is public or private. (*)
- To create a new survey, firstly a search should be performed on the questions/surveys in the system. After the search is completed, the user can select certain questions among them to be used in the survey. Certain surveys can also be modified to be used as a new survey. (*)
- The search operation mentioned above can only take place among the public questions/surveys in the system (*) and also the private questions/surveys of a user. (**)
- For each survey, the people who are eligible to participate in the survey can be added to a list one by one (*) or a user-group can be added (***). Also an e-mail message can be sent to the people in that list. (***)
- While filling in a survey, it will be possible to navigate among the questions. (**)
- The survey is finished when the user submits the answers. (*)
- At the end of the survey, the users can see the results of the survey that they participated in. (*)
- A survey can be deleted or modified (by adding or removing questions to it) if it is not submitted by anyone. (*)

Statistics

- The exam statistics can be shown by including information such as the number of participants and the average score etc. (*) Statistics for each question in the exam can also be shown (**).
- The survey statistics can be shown by including information such as the number of participants etc. (*) Statistics for each question in the survey can also be shown. (**)

- Statistics for each question in the system can be shown by including information such as the number of people who answered that question and the average score for that, number of people that answered it correctly etc. (**)
- Statistics of each person taking an exam can be shown in a format like a grade book. (***)

3.2. Software Requirements

User Requirements:

- Any Java enabled browser since the system is web-based

Development Requirements:

- Any IDE that gives support to Java development and JSP in particular (such as Sun Java Studio Creator etc.)
- A database management system (such as mysql), preferably including an easy to use user interface

System Actors

The following users are allowed in the system: Visitors, test participants, Test creators and system administrator. The explanations of these actors and services provided by each actor are given below along with the explanations of some of the services as necessary (Most of the services are not explained in order not to duplicate the content for those that have already been explained in the Functional Requirements section):

Visitor

The visitors have no permission other than performing sign in operation since at first they need to be authenticated by the system for performing additional tasks.

Services provided for Visitor are listed below:

- Become member

Test participant

The test participants have partial permissions so they can only take tests (exams/surveys) and see their results.

Services provided for Test participant are listed below:

- Manage account: This includes modifying an existing account (such as defining user parameters like the number of questions to be displayed per page etc.).
- Take exam
- See correct answers of taken exams
- Print exam results of taken exams
- See exam results of taken exams
- See overall exam statistics of taken exams
- See question statistics of taken exams

- Take survey
- See overall statistics of taken surveys
- See question statistics of taken surveys
- Receive notifications: The test participants receive notifications about the exams that they should take and surveys they can participate.
- Log out from the system

Test creator

Test creators have partial permissions: They can take tests other than the ones they prepared and see their results. They can also create/edit questions and tests and see their statistics.

Services provided for Test creator are listed below:

- Manage questions: This includes creating a new question and modifying/deleting an existing one. Note that a question can only be modified or deleted if it is not used in any survey or exam.
- Manage tests: This includes creating a new test and modifying/deleting an existing one. Note that a test can only be deleted or modified (by adding or removing questions to it) if it is not submitted by anyone.
- See statistics for test creator
- See all exam statistics: This includes both taken exams and the exams created by him / her.
- See all survey statistics: This includes both taken surveys and the surveys created by him / her.
- See exam question statistics: This includes the statistics of exam questions which are public or created by him / her.
- See survey question statistics: This includes the statistics of survey questions which are public or created by him / her.
- See question statistics of taken exams
- See question statistics of taken surveys
- Send mail to system administrator: A notification message is sent to the administrator in case of the need for operations such as adding, deleting or renaming a category and deletion of a user account.
- Manage account
- Take exam
- See correct answers of taken exams
- Print exam results of taken exams
- See exam results of taken exams
- Take survey
- Send/Receive notifications: The test creator receives notifications from the system administrator about events such as the categories opened, deleted, renamed and user groups created. The test creators also receive notifications about the exams that they should take and surveys they can participate
- Log out from the system

System administrator

The system administrator has all permissions.

Services provided for System administrator are listed below:

- **Manage categories:** This includes creating a new category modifying/deleting an existing one and changing the category of a question upon the request of a test creator or his/her own will.
- **Send mail to test creator:** A notification message is sent to the test creators when operations such as adding, deleting or renaming a category and deletion of a user account are performed.
- **Perform user account modifications:** This includes approving new test creator user account or modifying/deleting an existing one. The admin has to approve a new test creator user account since test creators have the largest set of permissions after the admin.
- **Manage questions:** This includes creating a new question and modifying/deleting an existing one. Note that a question can only be modified or deleted if it is not used in any survey or exam. Following this action, a notification message is sent to related test creators.
- **Manage tests:** This includes creating a new test and modifying/deleting an existing one. Note that an exam can only be deleted or modified (by adding or removing questions to it) if it is not submitted by anyone. Following this action, a notification message is sent to related test creators.
- **Manage user groups:** This includes creating a new user group.
- See statistics for system administrator
- See exam statistics of whole system
- See survey statistics of whole system
- See exam question statistics of whole system
- See survey question statistics of whole system
- **Send/Receive notifications:** The system administrator receives notifications from the test creators about requests such as the categories to be opened, deleted, renamed and user groups created. After these operations are performed by the administrator, notifications are sent to the related people.
- Log out from the system

4. Usage Scenarios

In this section, some usage scenarios are provided to reflect how the system accomplishes some fundamental tasks. We explained only the main and most important scenarios which are enough to capture the working mechanism of the system as follows:

4.1. **Create exam**

1. The test creator logs in to the system.
2. To create a new exam from scratch, the test creator firstly performs a search among the questions in the system.
3. After the search is completed, the user selects certain questions among them to be used in the exam.
 - The search operation mentioned above can only take place among the public questions in the system and also the private questions that are created by the test creator who is creating the exam
4. The test constructor determines whether the exam is public or private.

5. The test creator determines a certain time period during which the exam will be available.
6. A time limit is defined for the exam by the test creator, denoting the maximum duration for the exam to be completed.
7. The people who are eligible to take the exam are added to a list one by one or a user-group can be added by the test creator.
8. The test creator submits the exam to the system.
9. An e-mail message is sent to the people in that list.
10. To create a new exam from the existing exams, the test creator firstly performs a search among the exams in the system.
11. After the search is completed, the user selects certain exams among them to be used as a new exam.
 - The search operation mentioned above can only take place among the public exams in the system and also the private exams that are created by the test creator who is creating the exam
12. The exam is modified by adding or removing questions to it and adjusting its parameters that are defined in steps 4-9.

4.2. *Take exam*

1. The test participant logs in to the system
2. The test participant sees a notification about the exams that he/she should take.
3. The test participant selects the exam he/she wants to take.
4. The test participant is directed to the selected exam.
5. The test participant starts the exam.
6. The test participant answers the questions by selecting the only correct answer. It is also possible to navigate among the questions during this process.
7. The exam is finished if the time is over or the test participant submits the answers.
8. At the end of the exam, the test participant sees his/her scores along with the correct answers.

4.3. *Create question*

1. The test creator logs in to the system.
2. The test creator opens the “add a new question” screen.
3. The question is defined as public or private.
4. The test creator selects the category and sub-categories of the question.
5. To create a question, the test creator firstly enters its title.
6. The test creator edits the content of the question (the question itself and its answer part) which can be consisted of text or images.
7. For survey questions category, the test creator selects the question type.
8. For exam questions, the test creator selects the difficulty level on a defined scale.
9. The test creator submits the question to the system.

4.4. *Delete category*

1. The Test creator logs in to the system.
2. The Test creator selects a category to be deleted.
3. The Test creator fills in a form by providing the following information:
 - Explanation of the reason of the delete operation;

- Indication of the category to which the questions of the deleted category will be moved before the delete operation;
 - Indication of whether the questions in that category will be deleted.
4. An e-mail is sent to the system administrator which contains the form above.
 5. Then the system checks whether there are questions in that category or not.
 6. If that category is empty the delete operation is performed without any further checks and scenario continues from step 11.
 7. If that category is not empty and the questions are not to be deleted, the questions in it are moved to the preferred category denoted in the form by the system administrator.
 8. For the delete case, the questions in the deleted category are checked to find out whether they are used in any test or not.
 9. If the questions in the deleted category are used in any test then the category is not deleted.
 10. If they are not used anywhere the delete operation is performed.
 11. Afterwards, when the category is deleted a reply is sent to the requester of this operation and other related people.

5. Diagrams

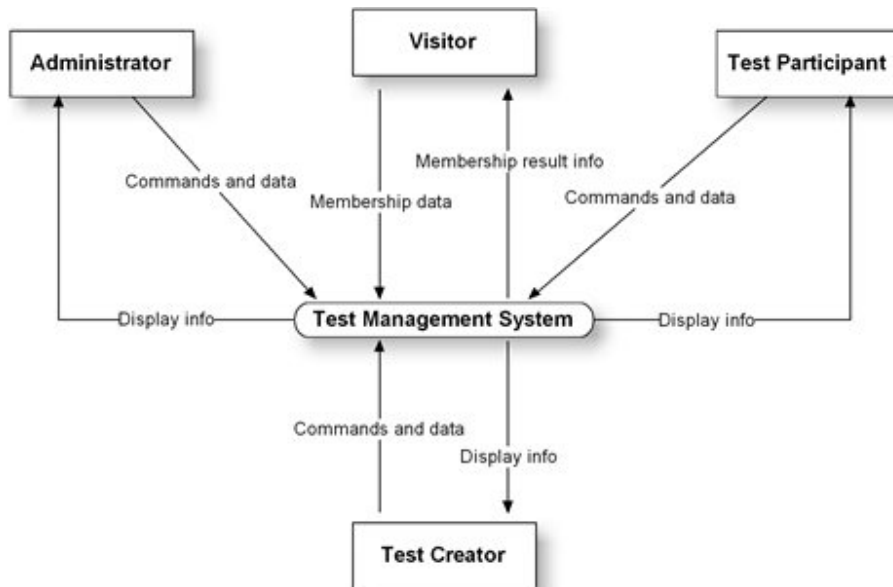
5.1. Use case

The use case diagrams of the system which are based on the explanations of these actors and services provided by each actor are given below:

5.2. DFDs

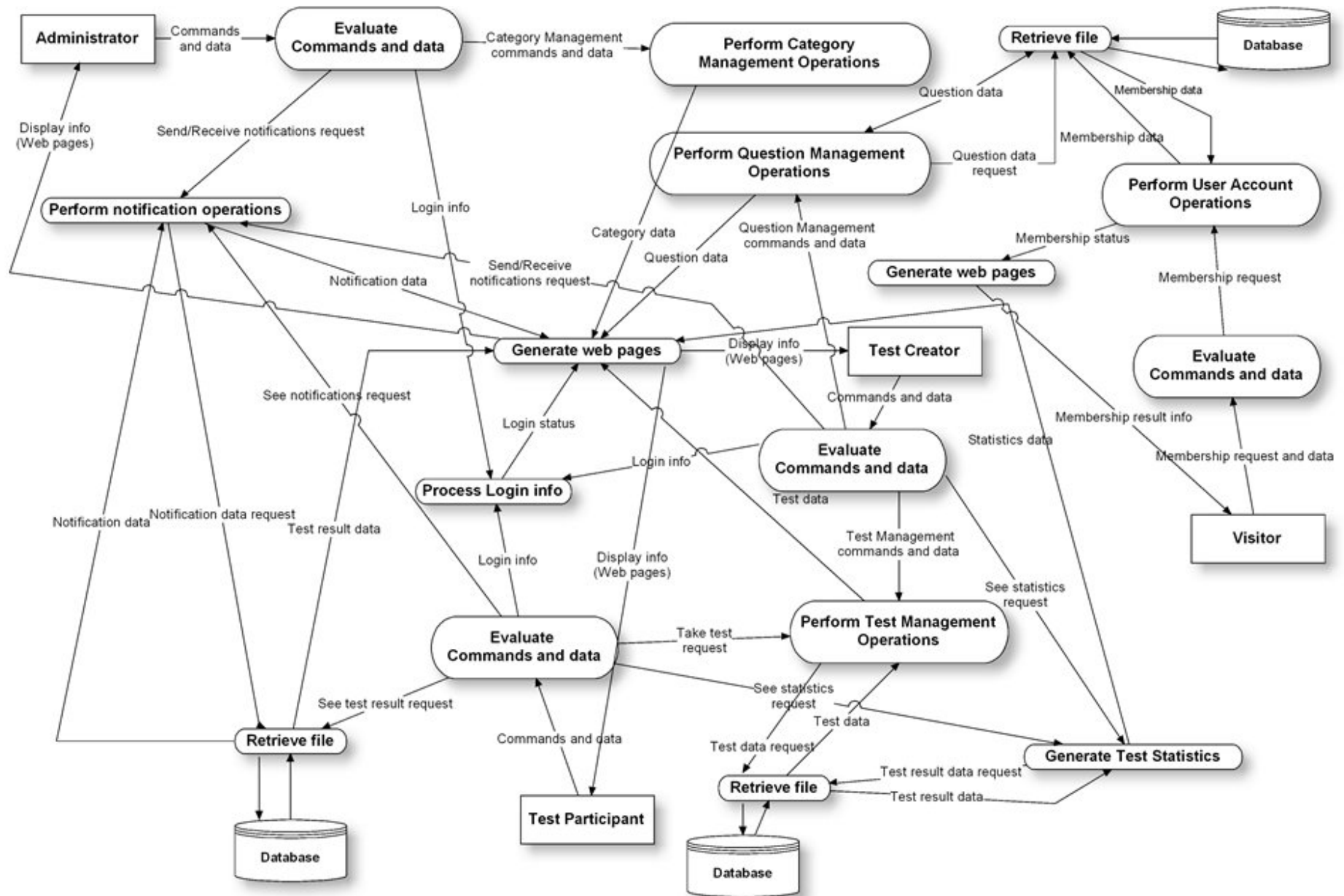
5.2.1. Level 0 DFD

In this section, the level 0 DFD of the system is provided which shows an overview of the system including the major inputs and outputs of it to the users of it; as follows:



5.2.2. Level 1 DFD

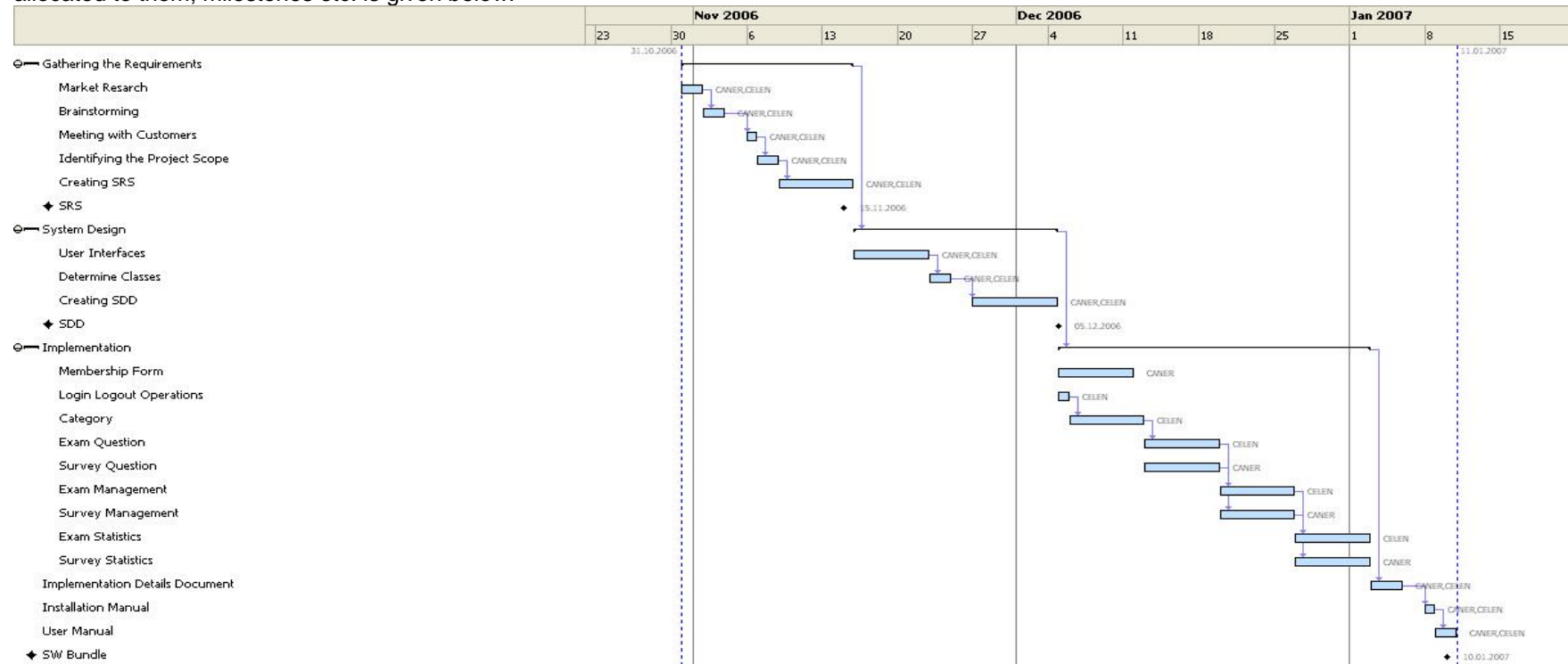
In this section, the level 1 DFD of the system is provided which shows the inner working details or data flows of the Test Management System. In this diagram only the major data flows are shown. Some flows are omitted in order not to over-complicate the diagram. For the visitors the only data flow is about becoming a member to the system. The test participants can take tests, see test results, see test statistics and see notifications. The test creators can perform question and test management operations, send/receive notifications and see test statistics. They can also perform all the operations that test participants can accomplish but these are omitted in this diagram because of the above reasoning. It should also be noted that all users can perform user account operations but it is only shown for the visitor. For the administrators, the data flows shown are about performing category management and send/receive notifications operations. In fact they have permission to perform almost all kinds of operations in the system but they are omitted since their most critical ones are the ones shown in the diagram below:



6. Project Plan

6.1. Work Breakdown Structure and its Schedule

In this section the set of tasks (the work breakdown structure) that will be carried out through the project schedule are visualized with a Gantt chart. This chart which conveys various information about the tasks such as their durations, start-end dates, dependencies among them, resources allocated to them, milestones etc. is given below:



The project table given below is like a textual representation of the Gantt chart given above:

Task Name	Duration	Start Date	End Date	Resources
Gathering the Requirements	12 day(s)	31.10.2006	15.11.2006	CANER; CELEN
Market Resarch	2 day(s)	31.10.2006	01.11.2006	CANER; CELEN
Brainstorming	2 day(s)	02.11.2006	03.11.2006	CANER; CELEN
Meeting with Customers	1 day(s)	06.11.2006	06.11.2006	CANER; CELEN
Identifying the Project Scope	2 day(s)	07.11.2006	08.11.2006	CANER; CELEN
Creating SRS	5 day(s)	09.11.2006	15.11.2006	CANER; CELEN
SRS	0 day(s)	15.11.2006	15.11.2006	
System Design	13 day(s)	16.11.2006	04.12.2006	CANER; CELEN
User Interfaces	5 day(s)	16.11.2006	22.11.2006	CANER; CELEN
Determine Classes	2 day(s)	23.11.2006	24.11.2006	CANER; CELEN
Creating SDD	6 day(s)	27.11.2006	04.12.2006	CANER; CELEN
SDD	0 day(s)	05.12.2006	05.12.2006	
Implementation	3 week(s)	05.12.2006	02.01.2007	CANER; CELEN
Membership Form	5 day(s)	05.12.2006	11.12.2006	CANER
Login Logout Operations	1 day(s)	05.12.2006	05.12.2006	CELEN
Category	5 day(s)	06.12.2006	12.12.2006	CELEN
Exam Question	5 day(s)	13.12.2006	19.12.2006	CELEN
Survey Question	5 day(s)	13.12.2006	19.12.2006	CANER
Exam Management	5 day(s)	20.12.2006	26.12.2006	CELEN
Survey Management	5 day(s)	20.12.2006	26.12.2006	CANER
Exam Statistics	5 day(s)	27.12.2006	02.01.2007	CELEN
Survey Statistics	5 day(s)	27.12.2006	02.01.2007	CANER
Implementation Details Document	3 day(s)	03.01.2007	05.01.2007	CANER; CELEN
Installation Manual	1 day(s)	08.01.2007	08.01.2007	CANER; CELEN
User Manual	2 day(s)	09.01.2007	10.01.2007	CANER; CELEN
SW Bundle	0 day(s)	10.01.2007	10.01.2007	