A Survey on Software Testing

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Abstract
Software testing is the most important phase of the software development life cycle. Around 50% of money and resources are used for the software testing. Testing can be manual or automated. There are basically three levels of testing are: Unit testing, Integration testing and system testing. When we develop any software, application or web sites try to make error free and reliable. At that time the testing are used which has find the errors and bugs and try to make it error free. In software testing there are many test cases and techniques are used to find out the bugs. In this we have define the different techniques, methods and levels of the testing which has used to design the test cases.
Keywords- Software Testing Techniques, Software Testing Methods and Software testing levels.

1. INTRODUCTION
1.1 Software Engineering: Software engineering is the branch of engineering which has deal with the development of software product using well-defined principles, methods, techniques and procedures. Software engineering deals with all kind of software production, design to coding, software accuracy and deals with the testing of the software and applications. It is a systematic approach to the analysis, design, implementation and maintenance of software. Software engineering is the process of making, testing and documenting computer programs.

1.2 Software Development Life Cycle: Software development life cycle is a methodology which introduces the different phases of software product. In SDLC we usually passes from various phases that is project definition, requirement of the user, requirement of system, analysis and design, implementation, testing and maintenance. In SDLC we need to check the requirement of user and to design the system according to the requirement of user. Later on we just code the program then apply the testing on the system which is one of the most important phases in SDLC. Here you can able to find any bug or error in the earlier stage, so that you can fix it. After completion the testing of software it is get ready to implement.

The different Phases are:
1. Requirement gathering and analysis
2. Design
3. Implementation and Coding
4. Testing
5. Maintenance

The Figure1 shows the diagrammatical representation of all phases involved in development of particular software:
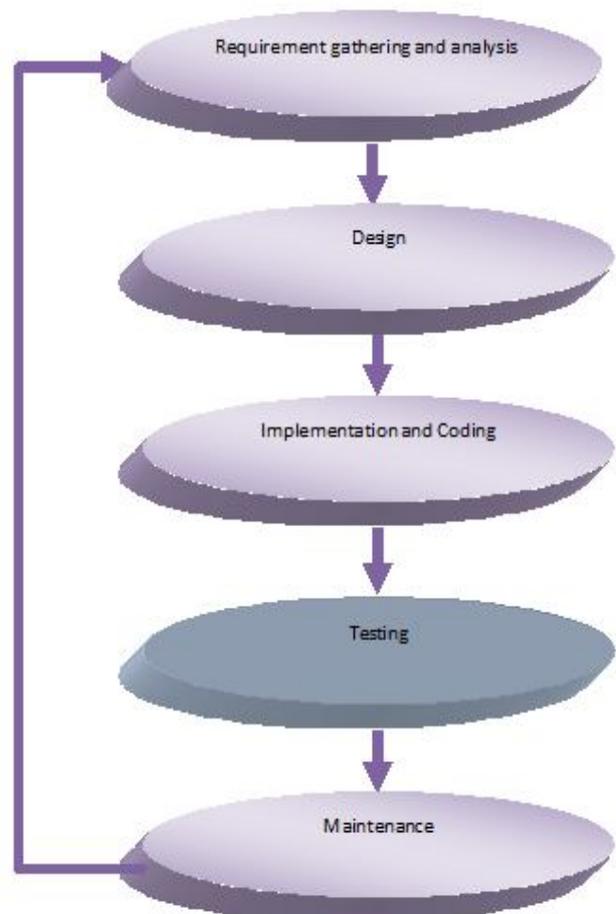

Figure 1 Phases of SDLC

1.3 Software Testing:

Testing is executing the system to identify the gaps, error and any missing requirements. Testing is the process of evaluating the system and components to find whether to satisfy the specified requirement or not. According to ANSI/IEEE 1059 standard, Testing can be defined as "A process of analyzing a software item to detect the differences between existing and required conditions (that is defects/errors/bugs) and to evaluate the features of the software item". Software testing is an important part of software quality assurance and many organizations spend more than 50% of their time and resources on testing.

Software testing is the process of executing a software system to determine that it matches its specifications and requirements. The testing process can be divided into three steps-test case generation, test case execution and test evaluation.

1.3.1Software Testing Techniques:
There are two main techniques are used for testing:
1. Manual Testing (Static Testing)
2. Automated Testing (Dynamic Testing)

1. Manual Testing: This type of testing is done manually. In this type of testing we do not use any type of automated tools or test scripts. In this tester take as the role of end user and test the software to identify the unexpected behavior or bugs. It is done by developer, analyst and testing team. There are different stages for manual testing like unit testing, integration testing, system testing, acceptance testing.

2. Automated Testing: In this type of testing the tester writes some scripts and uses some other software to test the software. Automation testing is re-run the test scenarios that were performed manually. From regression testing, Automation testing is also used to test the load, performance and stress point of view [2].

Automated testing is also classified into four types:
(i) Correctness testing
(ii) Performance testing
(iii) Reliability testing
(iv) Security testing [3]

1.3.2 Software Testing Methods
There are different methods used for the testing:
1. Black box testing
2. White box testing
3. Gray box testing

1. Black box testing: The testing which does not have any knowledge about the internal working of the applications. In Black box testing the tester aware about what the software supposed to do, not aware about how it does it. In this testing tester make sure that the input is properly accepted and output is correctly produced.

Different types of black box testing techniques are use:
(i) Equivalent Partitioning
(ii) Boundary value Analysis
(iii) Cause-Effect Graphing Techniques
(iv) Comparison Testing
(v) Fuzz Testing
(vi) Model-based testing [4]

2. White box testing: White box testing is the detailed investigation of internal logic and structure of the code. White Box testing is the process of giving the input to the system and checking how the system are process the input to generate the desired output. In the White box testing the tester need to have a look inside the source code and find out which unit of the code having given the problem. It is also called clear box testing, open box testing.

Different types of white box testing techniques are:
(i) Basis Path Testing
(ii) Loop Testing
(iii) Control Structure Testing [4]

3. Gray Box Testing: Gray box testing combined the methods of White box testing and Black box testing. Gray box testing is the technique to test the application using some knowledge of the internal working of an application. In the black box testing the tester can only tests the application's user interface, but in Gray box testing the tester have access to design documentation and database. Having this knowledge tester is able to prepare good test data and test scenarios to make the test plan and test cases.

1.3.3 Software testing Levels
Levels of testing include the different testing methodologies that can be use while conducted the software testing. Software testing has two main levels:

Figure 2 Software Testing Levels

1. Functional Testing: Functional testing is the type of the Black box testing that is performed to verify the specification of the system that is to be tested. During the functionality testing we check the core application functions, text input, main functions and installation and setup on local machine.

Function testing involves six steps:
  a) The identification of functions that the software is expected to perform.
  b) The creation of the input data based on the function's specification.
  c) The determination of output based on the function's specification.
  d) The execution of the test case.
  e) The comparison of actual and expected outputs.
  f) To check whether the application work as per the customer's requirements.

(i) Unit Testing: Unit testing is done at the lowest level. Unit testing is the smallest module or smallest collection of line of code that can be tested by the developer. It is just a small level of the testing which has made the big picture testing of the system.

(ii) Integration Testing: It is done when two or more tested units combined into a large structure. Integration testing occurs after the unit testing and before the validation testing.

Two approaches are used for integration testing:

a) **Top down Integration**: In this first highest level module are tested and after that lowest level module are tested. Modules are integrated moving downward through the structure.

b) **Bottom up Integration**: Testing begins with unit testing. In this testing the lowest level component are tested first, then the higher level component are tested.

A bottom-up integration strategy may be implemented with the following steps:

1. Low-level components are combined into clusters that perform a specific software sub-function.

2. A driver is written to coordinate test case input and output.

3. The cluster is tested.

4. Drivers are removed and clusters are combined moving upward in the program structure.

(iii) System Testing: System testing is that which has tested the whole system. Once the entire components are integrated then the whole system is tested to see that it meets the Quality standards. System testing is basically used the black box testing because in this it should not require the knowledge of inner design of the code. It is needed because it tests the application thoroughly to verify that it meets the functions and technical specification.

Different types of system testing are:

1. Recovery Testing
2. Security Testing
3. Graphical User Interface Testing
4. Compatibility Testing [3]

(iv) Acceptance Testing: Acceptance testing is conducted by Quality assurance team who will verify the product is meeting the user's requirements. The QA team will have pre written scenarios and test cases that will be used to test the applications. This type of testing is also carried out by user and customer where the product is generally developed by another party. Acceptance testing falls under the black box testing where the user is not interested in internal working or coding of the system but evaluate the overall functionality of the system and compare it with their requirements. Acceptance testing is also known as validation testing, final testing, QA testing etc. Acceptance testing is carried out at two levels: system provider level and end user level.

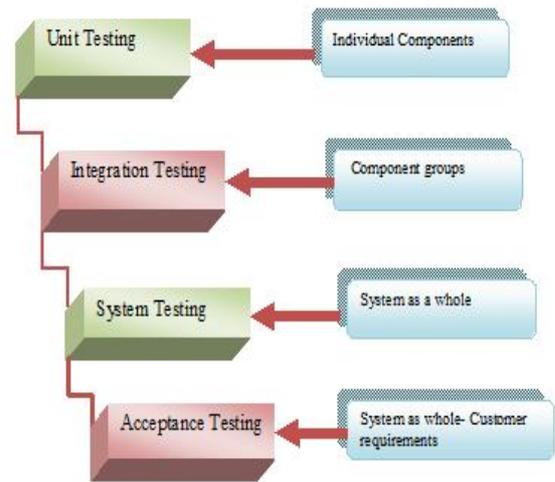There are two types of acceptance testing:

a) Alpha Testing
b) Beta Testing

Figure 3 Software system strategies

(a) Alpha Testing: This type of testing is performed by the developers and QA team. Unit testing, Integration testing, System testing when these are combined are known as alpha testing. During this phase, the following will be tested in the application:

➢ Spelling Mistakes
➢ Broken Links
➢ Cloudy Directions
➢ The Application will be tested on machines with the lowest specification to test loading times and any latency problems.

(b) Beta Testing: This type of testing is performed by the end users. In this the user provides the feedback to the developer for outcome of the testing. Feedback from the user to improve the product or system before it is released to other users and customers.

In this testing the user will be testing the following:

➢ Users will install, run the application and send their feedback to the project team.
➢ Typographical errors, confusing application flow, and even crashes.
➢ Getting the feedback, the project team can fix the problems before releasing the software to the actual users.
➢ Having a higher-quality application when you release to the general public will increase customer satisfaction.

2. Non-Functional Testing: Non-functional testing is that which has tested the quality characteristics of the components. It is that in which are not related to any specific function or user action like performance scalability or security of application under certain constraints.

There are different types of non-functional testing:

(i) Performance Testing: Performance testing is used to identify the bottleneck or performance issue rather than finding the bugs and error in software. There are different causes which has effect the performance:

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- Network Delay
- Database transaction processing
- Load balancing between servers
- Data rendering

Performance testing is that which has improve the speed, stability, scalability and capacity of the system. It can be divided into two sub parts:

a) Load Testing

b) Stress Testing[5]

(ii) Usability Testing: Usability testing is a black box technique and is used to identify any error and improvements in the Software by observing the users through their usage and operation.

According to **Nielsen**, Usability can be defined in terms of five factors i.e. *Efficiency of use, Learn-ability, Memor-ability, Errors/safety, satisfaction.* According to him the usability of the product will be good and the system is usable if it possesses the above factors.

(iii) Security Testing: Security testing is that which has made sure that the authorized user can access the program and only authorized user can access the functions available to their security level. Security testing ensure that:

- Confidentiality.
- Integrity.
- Authentication.
- Availability
- Authorization.
- Non-repudiation.
- Software is secure against known and unknown vulnerabilities.
- Software data is secure.
- Software is according to all security regulations.
- Input checking and validation.

(iv) Portability Testing: Portability testing is the sub part of the system testing that has test the overall software with respect to its usage over different requirements. Computer hardware, operating system and browser are major focus on Portability testing. Some pre-conditions for Portability testing are:

- Software should be designed and coded, keeping in mind Portability Requirements.
- Unit testing has been performed on the associated components.
- Integration testing has been performed.
- Test environment has been established.

2. CONCLUSION

Software testing is mainly used to find out the bugs from the software and make it error free. This paper is basically defined the software testing techniques, methods and levels. But in future we can enhance the techniques and explain the testing tools.

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