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A Comparative Study on Testing Techniques of Software

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Abstract:- Software Testing is done taking the aim of finding the errors in the software's. Errors can be occurred at any stage of the development or testing phase, it can occurred even after the deployment. The aim of this paper is to describe about various popular Software Testing. It further gives the summary of different Software Testing and also gives the comparison between them to find out the best one in order to find the errors.

Method:- I compare some of the popular Software Testing Techniques on the basis of their point of focus in doing testing of the software, summarize them and provide a conclusion that which one is the finest.

Keywords:- *Software, Software Testing, Software Development Stages, Software Testing Techniques, White Box Testing, Black Box Testing, Grey Box Testing, Agile Testing, Smoke Testing, Acceptance Testing, Adhoc Testing, Security Testing.*

I. INTRODUCTION

Software Testing is the process of checking the quality of the Software System. It should be performed by Software Testing Engineer. The Software should also be checked at the Customer's level as to give the reviews (either good or bad) to the developer. By performing the testing of the software the feedback is which works as the next target for the developer. Software can be tested at any phase but it should be planned before start implementation. The main goal is to perform testing systematically and stepwise with the aim of giving fewer amounts of time and effort.

Some of the Testing's that are described in this paper are-

- White Box Testing
- Black Box Testing
- Grey Box Testing
- Agile Testing
- Smoke Testing
- Acceptance Testing
- Adhoc Testing
- Security Testing

II. TERMINOLOGY

Software- The set of programs, documentations and operating procedures.
Software Testing- Software testing is the process in which the quality of the Software System is checked.
Fault or Defect- When an incorrect step, any wrong process or wrong data definition is occurred in the program.
Error- The difference between the actual result and the result after the testing.

III. LITERATURE REVIEW

Divyani Shivkumar Takey, Dr. Bageshree Pathak (2020) described in their study about Software Testing and its aspects like Techniques of Software Testing and also Strategies of Software Testing. They further described some basic life cycles that are needed in testing the quality. The conclusion was in manual testing the design of test cases are done by Human Testers while in Automation Testing the Automation Tools are needed. They further concluded that Automation Testing needed less complex testing as compared to Manual Testing [1]. Arun Kumar Arumugam (2019) described in their research about existing and improved testing techniques that are used for the assurance of the better quality of the project. They further described about the testing metrics. The conclusion was that testing is main part of the Software Development Life Cycle because the final delivery of the product depends on the same [2]. [1] J. Punitha, [2] S. Nivetha, [3] Dr. M. Inbavalli (2018) described in their paper about the discussion between three types of testing namely- black, white and grey box testing techniques. They further described about the testing strategies, common errors that occurs and bug report. The conclusion was that bug report plays a vital role in finding software bugs in the future [3]. Er Suruchi (2016) gives the analysis and comparison of various testing techniques with the aim to find the best technique in order to find errors. They also described about the Phases that are involved in the Software Testing Life Cycle. They further described about the Unit Testing, Integration Testing, System Testing, Acceptance Testing and also various Software Testing Methodologies like Black Box, White Box and Grey Box. The conclusion was that main focus in software engineering project is Quality [4].

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Mihai Liviu (2014) in their paper described various specific characteristics that are involved in Software Development Project Management. They compared them by focusing on strengths and weakness. They compared them on the basis of the users (directly or indirectly connected with project) point of view. The conclusion was Software Development Methodologies work with two philosophies- heavyweight & lightweight [5]. [1] Keertika Singh, [2] Sumit Kumar Mishra, [3]Gaurav Shrivastava (2014) described in their paper about the brief summary on Software Testing Approach and Techniques. They further include about Code Coverage, Prototyping Testing and Traceability. They also deal with the- important issues that occurred in testing. The conclusion was that the main goal of testing is to find the errors before deploying it to the clients and to understand reasons behind testing [6]. Antonia Bertolino (2007) described in their research that testing is widely spread approach for validation in industry but at the same time it is still expensive. They start their research from some past achievements and their final destination consists of four identified goals to which research tends. The conclusion was that there are many relations amongst software testing & other research areas [7].

IV. SOFTWARE DEVELOPMENT STAGES

When software is to build it has to go through certain stages before the completion. Each and every stage has its own importance and is necessary in the development of the software. In the process of building software there are many stages that are followed by any organization in order to give the final project.

A. Research
B. Planning
C. Design
D. Development
E. Testing
F. Setup
G. Maintenance

A. Research- In this stage of the software development, exchange of the information is done between the clients and the company. In this stage the Project Owner do his best to find the people that are needed on the software and also which have the knowledge of the things that related with the project in the aim of complete the goal on time.

B. Planning- It is the stage in which we organize all the elements required for the development of the software product. The start of the Planning Phase is performed by making design of the overall flow regarding the application. It further performs the cracking of the module into smaller parts that are easy to work. After all this the product manager should decide management things and the protocol that are needed.

C. Design- It is the stage in which the model of the project is made. Web Applications and Mobile Applications are becoming more and more important of layout in comparison to desktop applications. After this stage the project owner may get the new requirements that were not examined in the Research and Planning Stage.

D. Development- It is the stage in which the code of the software is written and it is stage from where the actual building of the software application is started. It starts with creating the environment for development and testing purpose. The code is written on the development environment code and is further posted on the testing environment. The project manager is responsible for determining the progress and comparison with initial planning.

E. Testing- It is the stage where identification of the errors is done and the developers try to fix them. Testing can be divide into two kinds i.e., Manual Testing and Automation Testing. Automation Testing is easier as compared to Manual Testing.

F. Setup- It is the stage where installation of the application is done. The setup involves the information that is related with security, hardware and software resources. After the establishment of the product it is again reviewed and tested.

G. Maintenance- It is the stage which covers improvement resulting to the application and furthermore it is liable for guaranteeing that the application is running inside the range of the software.

These above mentioned stages are accepted by the most of the Software Development Groups as there are foundations of developing a software project. They can be found with some other name in some different Software Development Methodology.

V. SOFTWARE TESTING TECHNIQUES

There are plenty of Software Testing Techniques that are used by the Testers to find the errors in the Software for resolving them to get the better product. Some of the testing's that are described in this paper are -

- White Box Testing
- Black Box Testing
- Grey Box Testing
- Agile Testing
- Smoke Testing
- Acceptance Testing
- Adhoc Testing
- Security Testing

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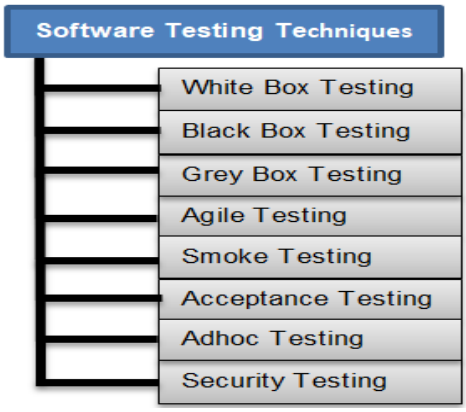

Fig. 1 Kinds of Software Testing Techniques

I. White Box Testing- The main goal of this technique of Software Testing is to check the inner functionalities of the software. It can be further divided into following kinds-

1. Path Testing
2. Loop Testing
3. Condition Testing

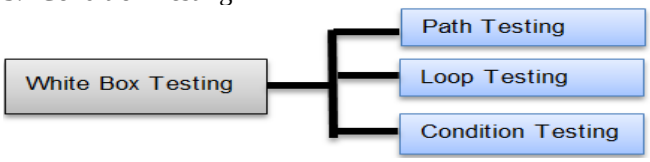

Fig. 2 Types of White-Box Testing [10]

i. Path Testing- In this type of white-box testing the flow graphs are made and all the paths are tested independently with the goal of finding errors.

ii. Loop Testing- In this type of white-box testing, all the loops that are included in the software are tested to examine whether they are working accordingly or not.

iii. Condition Testing- In this type of white-box testing, all logical conditions are checked for finding the errors. In this both if & else conditions are examined [10].

II. Black Box Testing- The main goal of this technique is to focus on the final outputs of the software, it need not to focus on the inner working. It can be further divided into following that are as follows-

i. Functional Testing
ii. Non-Functional Testing

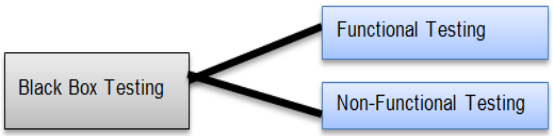

Fig. 3 Types of Black-Box Testing [8]

i. Functional Testing- In this type of black-box testing all the components are examined by providing some values, identifying outputs and checking the actual outputs with the expected one. This testing is also known as Component Testing. The functional testing can further be divided into following-

a. Unit Testing
b. Integration Testing
c. System Testing

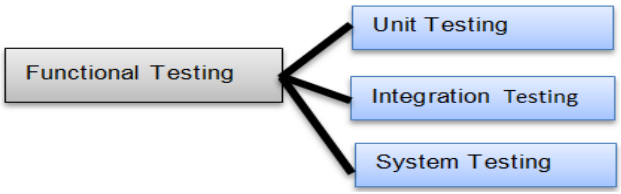

Fig. 4 Types of Functional Testing [8]

a. Unit Testing- It is one of the most popular techniques that are used in the organizations. Unit the word itself suggests the meaning that it is talking about the smallest thing. In this type of Software Testing Technique all the small modules developed by the developers are tested individually.

b. Integration Testing- As the word integration itself suggests that it means combination of something's. In this type of Software Testing Technique the modules that were tested individually are combined together and are tested in aim to find the errors.

c. System Testing- In this type of testing technique whole system is checked with the operating system in order find the errors.

ii. Non- Functional Testing- It gives the detailed overview on software product performance and technologies that are used. It can be further divided into-

a. Performance Testing
b. Compatibility Testing
c. Usability Testing

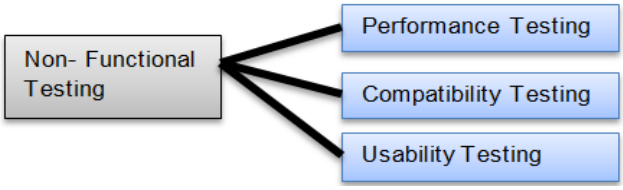

Fig. 5 Types of Non-Functional Testing [8]

a. Performance Testing- In this type of non-functional testing the test engineer focus on some specific key factors like- Load, Stress, Scalability and Stability.

b. Compatibility Testing- In this we have to examine the functionality of the software in some hardware and software environments.

c. Usability Testing- In this type of non-functional testing we focus on the requirements of user-friendly environment with the aim of finding the errors [8].

III. Grey Box Testing- The aim of this type of testing technique is to search the deformities if any because of ill-advised design or inappropriate use of utilization. It can be further divided into-

i. Matrix Testing
ii. Regression Testing
iii. Pattern Testing
iv. Array Testing

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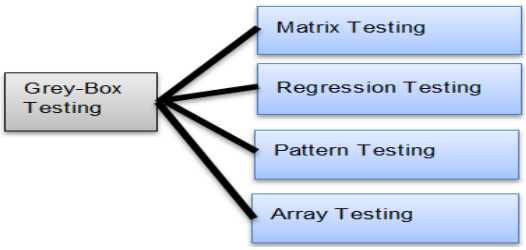

Fig. 6 Types of Grey-Box Testing [9]

i. Matrix Testing- We get the report of status of the software from this type of Gray-Box Testing.
ii. Regression Testing- It focus on the re-start of the test cases if the changes applied on the software.
iii. Pattern Testing- It's focus is basically on the design, architecture and patterns of the application.
iv. Array Testing- It is used as a subset of all combinations that can be made to test the software [9].

IV. Agile Testing- In this type of testing all the works are performed using the rules and regulations of the Agile Methodology. With the help of Agile we can save time and money. Documentation part is minimized when we are working with this type of testing. Interaction with the client is the most importance thing in this type of testing so they take regular feedback with clients [11].

V. Smoke Testing- This testing is performed when the software is already under testing with the aim to check whether it is ready for the further processing. They are said to be the subset of the test cases that usually covers the very important functionality with the aim of finding whether main functions work accordingly [12].

VI. Acceptance Testing- This type of testing is done at the client side in order to check that all the requirements are fulfilled or not and that to accept the project. It usually finds the defects that were lacked in the functional testing phase. It can be further divided into-

i. User Acceptance Testing
ii. Business Acceptance Testing
iii. Alpha Testing
iv. Beta Testing
v. Contract Acceptance Testing
vi. Regulations Acceptance Testing
vii. Operational Acceptance Testing

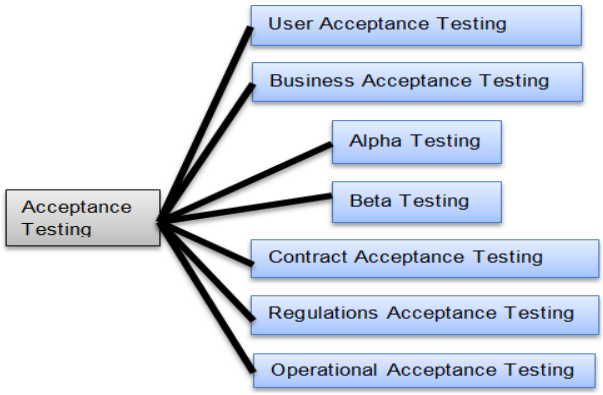

Fig. 7 Types of Acceptance Testing [15]

i. User Acceptance Testing- In this the software is fully checked that it is working according to the user requirements.
ii. Business Acceptance Testing- This is used for determining that whether the software is meeting the business goals that were discussed earlier.
iii. Alpha Testing- In this type of acceptance testing software is checked by the specialized testers. These testers are basically known as alpha testers.
iv. Beta Testing- In this type of acceptance testing software is deployed to some friendly users to test the software. Feedback is collected from them and after that changes are made in the software accordingly.
v. Contract Acceptance Testing- This testing is done after the product is live. In this type of acceptance testing one period is determined earlier and in that acceptance testing is performed. In this the software should perform accurately with all the test cases that are made for the acceptance of the software.
vi. Regulations Acceptance Testing- In this type of acceptance testing it is examined that software should not break the rules and regulations defined by the government.
vii. Operational Acceptance Testing- In this type of acceptance testing the main focus on testing of recovery, compatibility, maintainability etc. [15].

VII. Adhoc Testing- It is an unorganized type of software testing which focuses on interrupting the process of testing in between with the aim of finding defects at the early stage. In this type of testing we didn't need any documentation, planning and the processes that will be followed. It can be divided into following-

i. Buddy Testing
ii. Pair Testing
iii. Monkey Testing

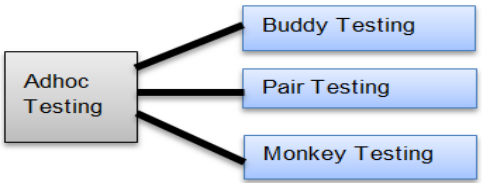

Fig. 8 Types of Adhoc Testing [13]

i. Buddy Testing- In this type of testing two buddies work on the same modules in order to find the errors if any. In this usually one person is from development team and the other is from testing team. This testing works in the favor of both the person's as it helps the testers to define better test cases and developers to make changes in the design in the earlier phase.
ii. Pair Testing- In this type of testing the two testers are given same modules for testing. They both share ideas and work on the same machines with the aim to find defects. One person executes the tests and the other one take notes of the findings of the tests.
iii. Monkey Testing- In this type of testing we randomly test the product or application. The main goal of this type of Adhoc Testing is system interruption [13].

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VIII. Security Testing- It determines whether the system is properly protected from the intruders that might be possible. It further examine the software application are free from risk or threats or not. It focuses on finding the weaknesses of the system. It can be further classified into-

i. Vulnerability Scanning
ii. Security Scanning
iii. Penetration Testing
iv. Risk Assessment
v. Security Auditing
vi. Ethical Hacking
vii. Posture Assessment

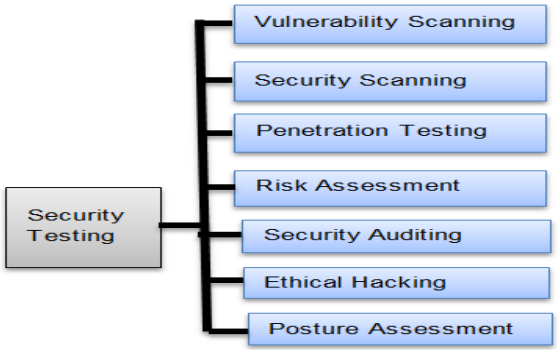

Fig. 9 Types of Security Testing [14]

i. Vulnerability Scanning- It is usually done with the help of automated software with the aim to scan the system to find the known vulnerability patterns.

ii. Security Scanning- It is done to find the network and system weaknesses. After that it provides the solution too for decreasing the risks.

iii. Penetration Testing- It is done to provide analysis of a system in order to examine attacks from hackers to hack the system.

iv. Risk Assessment- In these security risks are identified that can be observed in the organization. They can be further classified into- Low, Medium and High.

v. Security Auditing- It refers to the internal examination of applications and operating systems with the aim to inspect the security defects.

vi. Ethical Hacking- The main aim of this is to find out the security loopholes in the organization system.

vii. Posture Assessment- It combines various things like security scanning, ethical hacking and risk assessments in order to give an overall posture of security of an organization [14].

VI. SUMMARY

Sr. No.	Name	Performed By	Focus
1.	White Box Testing	Development Team	Internal Function of the system
2.	Black Box Testing	Testing Team	Outputs of system
3.	Unit Testing	Development Team	Small Modules
4.	Integration Testing	Development Team	Integrated Modules
5.	System Testing	Testing Team	Whole system with operating systems
6.	Performance Testing	Testing Team	Load, Stress, Scalability, Stability
7.	Compatibility Testing	Testing Team	Functionality of Software with Hardware & Software Environment
8.	Grey Box Testing	Testing Team	Improper Structure
9.	Agile Testing	Testing Team	Agile Methodology
10.	Smoke Testing	Quality Assurance Engineer	Ready for further processing or not
11.	Alpha Testing	Alpha Testing Team	They find the errors
12.	Beta Testing	Friendly Customer's	Friendly Customer's finds the bugs
13.	Acceptance Testing	Clients	Client check whether to accept or not
14.	Adhoc Testing	Development & Testing Team	Interrupt the process
15.	Buddy Testing	Development & Testing Team	Both work on same modules
16.	Pair Testing	Testing Team	Two Testers work on same modules
17.	Monkey Testing	Testing Team	Random Testing
18.	Security Testing	Development Team	Protect from Intruders

Table 1 Summary of Software Testing Techniques

VII. CONCLUSION

Agile Testing is the best technique amongst the above mentioned Software Testing Techniques because-

- It works on Agile Methodology
- Customer Interaction is the top priority
- It saves time and effort
- Less Documentation is needed
- Feedback is taken regularly
- Daily Meetings are conducted for resolving issues
- Test Driven Methodology

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