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ANALYTICAL STUDY OF USABILITY EVALUATION METHODS

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***Abstract*— The effectiveness of software can be evaluated with the help of important quality factors such as maintainability, portability, functionality, reliability, usability and efficiency. There is increase in demand for quality software systems, but most of them fail to fulfil the user expectations due to lack of usability of software. Usability is one of the most important quality factor in the field of software engineering which is not given the due importance even though studies shows that considerable amount of improvement in usability increases revenues. Usability ensures that the software is easier to learn, efficient and satisfying in use. Usability of software can be evaluated through many ways. In this paper, we have studied and drawn an analysis of different evaluation techniques.**

***Keywords*— Usability, Usability Evaluation Methods, Usability Testing, Walkthrough, Inspection**

I. INTRODUCTION

Usability makes the software quick and efficient to use. It also makes the software easy to learn and remember. Error recovery is much more rapid if the software is usable.

Usability of the software when improved benefits both the users and the provider. The user achieves their goals effectively and efficiently. They enjoy interacting with the software system and are not frustrated using it. Usability helps the user to have confidence and trust on the software system. The providers are benefited from usability in many ways, such as reducing development time and cost, user errors, support cost, training time and error. It also helps to increase the investment returns.

Usability has been defined in different ways in literature; some broad definitions of usability from different standards are listed next:

- "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [7].
- "The ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or component" [6].

Usability to consist of five kinds of attributes [11]:

- **Learnability:** User should be able to start the work in first go which means that the software should be easily learnable.
- **Efficiency:** The software should be efficient to use, the user should be able to understand the software fully and thereafter the yield will be high.
- **Memorability:** Software should be easy to remember so that the user should be able to use the software even after some period of time.
- **Errors:** The software should have low error rate due to which the users will not be able to make errors while using the software.
- **Satisfaction:** The software should be easy and pleasant to use.

II. LITERATURE SURVEY

The concept usability evaluation methods go back more than two decades [17] [10]. In the 1980s, usability testing done in laboratory became the famous usability evaluation method for examining interfaces which were either new or modified. This method was seen by developers as a way to minimize the cost and risk, increase sales and create a historical record of usability [13].Testing also involved user performance which included the evaluation of speed, accuracy and errors. User-based evaluation methods included verbal protocols [1], critical incident reporting [4] and user satisfaction ratings [12]. In the 1990s, in order to bring down the cost and time requirement many developers explored other methods. As usability testing occurs late in the development cycle, developers looked for methods that could be used earlier when the designing of the software just started [8] [14].

III. USABILITY EVALUATION METHOD

The user works on different tasks which are available in the software and the evaluators uses the results generated by the user to see whether the software helped to ful fill the tasks. Following are the most famous methods of usability evaluation technique and are discussed.

A. Coaching Method

In this method [9], user asks any system related question to a tester who will answer to the best of ability. The purpose of this technique is to discover the information needed by the user so that better documentation and training can be provided. It may also help in redesigning the software so that no further need of questioning can be required.

B. Co-discovering Leaning

During this usability test [9], while being observed two users perform similar task. They use the product as they would use in real situations. They help each other to attain common goals. Then they explain what they were thinking while working on the tasks.

C. Cognitive Walkthrough

In this method [2] [3], user tells about the complete experience with the software. It involves complete and detailed description of prototype, task, and list of actions, experience and knowledge. Step by step evaluation of the product takes place and the experience of the user is recorded for future references. The evaluators may include engineers, software developers, or people from marketing, documentation, etc

D. Heuristic Evaluation

A heuristic guideline [10] helps to guide a design decision or can be used to evaluate a decision that has already been made. Here several evaluators independently evaluate a system to come up with potential usability problems. Heuristic evaluation is best used as a design time evaluation technique; because it is easier to fix a lot of the usability problems

E. *Performance Measurement*

This technique [16] is used to obtain quantitative data about test participants' performance when they perform the tasks during usability test. There is no interaction between the participant and the tester during the test. It should be conducted in a formal usability laboratory so that the data can be collected accurately and unexpected interference can be minimized. Quantitative data is most useful in doing testing against predefined benchmarks. The technique can be used in combination with questionnaires so that both quantitative and qualitative data are obtained.

E. Question-asking Protocol

During this usability test [9], besides letting the test users to tell their thoughts, the testers prompt them by asking direct questions about the product, in order to understand their mental model of the system and the tasks, and where they have trouble in understanding and using the system.

F. Remote Testing

Remote usability testing [5] is used when tester(s) are separated from the participants. This means that the tester(s) cannot observe the testing process directly and that the participants are not in a formal usability laboratory. There are different types of remote testing. One is same-time but different-place, where the tester can observe the test user's screen through computer network, and may be able to hear what the test user says during the test. Another is different-time different-place testing, and recordings are used to evaluate the results.

H. Retrospective Testing

In this testing [9], a videotape has been made of a usability test session. The tester(s) can collect more information by reviewing the videotape together with the user participants and asking them questions regarding their behaviour during the test. So this technique is especially used where the interaction between the testers and the participants is restricted. But this technique is time consuming as each test takes at least twice as long. Another requirement for using this technique is that the user's interaction with the computer needs to be recorded and replayed.

I. Shadowing Method

During a usability test [9], the tester has an expert user (in the task domain) sit next to him/her and explain the test user's behaviour to the tester. This technique is used when it's not appropriate for the test user to think aloud or talk to the tester while working on the tasks.

J. Thinking Aloud Protocol

During the course of a usability test [9], the test users are asked to verbalize their thoughts, feelings, and opinions while interacting with the system. Two variations of thinking-aloud protocol technique are:

- **Critical response:** This requires the user to be vocal only during the execution of certain predetermined subtasks.
- **Periodic report:** This is used when the task is complex and makes it difficult for users to think aloud while performing the task at the same time. The user, therefore, verbalizes at predetermined intervals of time and describes what he is currently trying to achieve. The length of the interval depends upon the complexity of the task. This technique is very time consuming, so it is recommended for subdivisions of a task.

K. Usability Inspection

It is most widely used method. In this method [15], there is a group of experts studying the design layouts of the user interface. They provide their views on various aspects of user interface which are then utilized to alter various aspects of the user interface so as to overview the various problems which are identified during the inspection.

Table I consists of the comparison of different usability evaluation methods. The table shows to which level of application development, different usability evaluation techniques can be implemented. Usability testing does not have any importance in requirement stages. Its main uses are

in other stages of the application development such as design, code, test and deployment. The table shows how many usability experts, user and software developers are needed. It also shows whether the methods are efficient, effective and satisfactory. Different methods can be conducted remotely and the methods that can obtain quantitative data.

Usability Evaluation Method / **Comparison Parameters**		**Coaching Method**	**Co-discovery Learning**	**Cognitive Walkthroughs**	**Heuristic Walkthrough**	**Performance Measurement**	**Question-asking Protocol**	**Remote Testing**	**Retrospective Testing**	**Shadowing Method**	**Thinking Aloud Protocol**	**Usability Inspection**
Application Stages	Requirements	-	-	-	-	-	-	-	-	-	-	-
	Design	*	*	*	*	*	*	*	*	*	*	-
	Code	*	*	*	*	*	*	*	*	*	*	*
	Test	*	*	*	*	*	*	*	*	*	*	*
	Deployment	*	*	*	*	*	*	*	*	*	*	*
Personnel needed for evaluation	Usability Experts	1	1	1-4	4	1	1	1	1	1	1	1
	Users	4	6	0	0	6	4	5	4	4	4	0
	Software Developers	0	0	0-2	0	0	0	0	0	0	0	0
Usability issues covered	Effectiveness	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Efficiency	No	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No
	Satisfaction	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	No
Can be conducted remotely		No	No	No	Yes	No	No	Yes	No	No	No	Yes
Can obtain quantitative data		No	No	No	No	Yes	No	Yes	Yes	Yes	No	No

TABLE I
COMPARISON OF USABILITY EVALUATION METHODS

CONCLUSION

After studying different usability evaluation techniques it was clear that different methods can be applied to different situations. There are different methods available according to the time and cost available. Walkthrough and inspections are the most widely used techniques.

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