

New Work Flow Model Approach for Test Case Generation of Web Applications

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Abstract – Web applications become complicated, common and critical in every field of life due to which the quality and reliability of web applications is highly required. Web application's quality depends upon functionalities including both functional and nonfunctional requirements. Web application testing is interesting not only in functional testing but also in nonfunctional testing such as security and reliability. Web application's testing is very important for the production of the quality. All web applications are developed to satisfy the user's functional requirements. There are may be different functional requirements. The aim of testing web application to ensure that it is fully functional. There are two kinds of applications like desktop applications and web applications. In this paper we presented a workflow mode that covers the structural and behavioral information of web application. The model has some features. The first feature of the designed model is that the model must describe the overall structure of web based application, links pages and navigational behavior among them. Also we generate test cases with the help of the model using UML activity diagram that describes web application's dynamic behavior and activity flow. A Case Study is taken to demonstrate the presented approach.

Index Terms – Web applications, Activity diagram, Test case Generation, UML.

I. INTRODUCTION

The usage of Internet in all the fields education, banking, online shopping etc. has been growing the demand of web applications. The increasing demand of web application for performing critical activities has upraised the certain issues like reliability, usability, operability and security. Recent web applications are erudite communicating programs with intricate web based user interfaces that are dynamic unlike traditional ones. Development of reliable web application requires arduous testing methods that are extensive and cost-effective. AJAX, JSP,PHP, ASP languages are used to develop the web applications [1].Software are developed to satisfy functional and non-functional requirements. Due to emergent difficulty of web based applications increase new challenges for testing and modeling of the web application. Modeling is a good technique to understand the software / system. Due to modeling, developers / designers during design and developing get help for testing and validation etc. due to heterogeneous nature of web application, it is run as a

whole or partially on one or more web servers. A web based applications can consist on different pages that resides on the server and can be accessed by users through web browser [2] A model is an abstract and partial representation of system that is under testing. The models are used to show the desired behavior of a system that is under test.

The model captures the structural and behavioral test artefacts of web applications represents from three different features: i) the object feature, that is used to models the objects of web applications as objects with their needy relations; ii) the behavioral feature, that shows navigational behaviors of a web application; and iii) the structure feature, that defines flow of information of web application [3]. Web application testing can easily be model driven. Web application model is designed to define the system that is under testing [4].Test cases are yield from such a model that are functional tests. Test cases in model based testing are derived as in part or as a whole that represent the system under test [5].

Different web application modeling techniques for testing purpose have been analyzed and divided into three categories by authors: web navigation, web content and web behavior modeling. Web application navigation is the order of web pages that are visit by the users. It is important for handling errors in web applications [6].

A. Test Case Description

Combination of conditions for which a tester determines either a system meets requirements or not is called test case. During design phase or developing the software problems can be fined with the help of test case generation process. For the purpose of test case generation, the test case description is very necessary. Test case is combination of different items:

Test Case Identity, Test Case Description, Prerequisites, Test Steps, Input/data, Expected Results, Actual Result, Post requisites [7]. In this paper a workflow model technique is proposed to generate test flows and test cases for web applications through the navigation behavior. Many other others describe the importance of test case generation, test Case Identity, Test Case Description and introduce different methods. Some are discussed in this paper.

II. RELATED WORK

A. Test Case Generation

Automated test case generation is a process of generating test cases to be able to tool specific execution of test cases. In this section, we discuss related work presented regarding the automated test case generation work which is done in previous years. There are various techniques for automated test case generation that have done in the past. Here, we include some pervious research related about generation of test case automatically. The vital role of

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requirements in the development of software is that the users can check the functionality according their expected outputs or not concerning to the real output. In the past many researchers presented different technique for generation of test case from UML modeling. Possible requirements are essential to improve the software quality. Authors have proposed test case generation method UML based requirements analysis model. Usefulness of the model can be validate by simulating the code generated from requirements specification model [8]. Web applications become very intricate due to the nature of its heterogeneous and the key reason is distributed nature which requires arduous testing techniques. The authors proposed a hybrid technique for testing of medium scale web based applications. In the proposed method, weight of flows have been calculated with the help of UML activity diagram. To find trade-off between complete testing and effort level, the ideal distance is used and depicted by the graph [9].

This paper focus to produce and specify the requirements of software. These events are maintained with in the organization called requirement engineering. Main purpose of the research is purifying a precise practice in requirement engineering which is called Unified Modeling Language modelling. In this paper an integrated model based on modules is proposed that is validated by UML Modelling. By using this model we achieved the effective requirement engineering for small scale project. Presented technique is explained by Case Study [10].

The authors presents automatic test case generation from desires specifications for the real time embedded applications. The documentary requirements and actions for generation of test case make the early steps to understand model based code sign. The model system and prototypes are used to authenticate the requirements specification. This confirms consistency among the system models at many detail's level, the system prototype and the last system proposal. The automated test case generation process ensures that the test cases have been derivative in a reliable and impartial manner that ensure the meeting of all system requirements.

A heuristic formula to mechanically generate test cases is given. The inputs to the formula area unit extracted from the necessities specification. The goal is to create collection of test cases that give complete coverage of all documented system needs [11].

Software testing is the dynamic means in the software testing quality. The authors suggest a rules for reuse generation of test case and automatically test case generation method. The returnable test case is showed as software component. A match technique, presented for automated test case generation. Depending on this, the system test cases could be reprocessed and mechanically generated throughout the expansion of test case. The method of test case generation could increase test proficiency [7].

In this paper the authors present a tool that is used for testing a model using NL generator and verification of a model as per the given software's requirements. The aim of introducing the tool is to generate model automatically that decrease the cost of system verification and save the time.

The system's requirements are transformed using different diagrams [12]. Many other others describe the importance of test case generation, test Case Identity, Test Case Description and introduce different methods. Some are discussed in this paper.

The author discuss a technique for automatic test case generation from system requirements models. Test cased that automatically generated have several benefits such as automatic test-case generate on protects resources. Before to write any program code, test cases may be developed that will allowable for the developers for the usage of test cases. This decreases the number of repetitions between development and testing. Error occurs when requirements are not delivered to them at all. Software has developed a technique for automatically generating test cases from SpecTRM-RL models [13].

III. PROPOSED MODEL

It is software testing approach in which the system or software can be test that is based on the model. The models are used to show the desired behavior of a system that is under test. The model captures the structural and behavioral test artefacts of web applications represents from three different features: i) the object feature, that is used to models the objects of web application as objects with relationships; ii) the behavior feature, that shows the navigational behaviors of a web application; and iii) the structure feature, that defines flow of information of web application [3]. Web application testing can easily be model driven. Web application model is designed to define the system that is under testing [4]. Test cases are yield from such a model that are functional test cases.

In this paper we create the model that covers the information and the behavior about the structure of the web application. The model has some features. The first feature of the designed model is that the model must describe the overall structure of web based application. The structure must include the links pages and navigational behavior among them. The information about the behavior that is the flow of data, workflows that must be helpful to create test case.

The proposed workflow model represent the graphical structure and workflow of web based application. In workflow model, the circle represents the pages and arrows represents the flows of pages. Workflow model is demonstrated by mean of case study.

The proposed workflow model for "Online Career Guidance System" is as under:

The first feature of the model is fulfilled by creating the application model. This model depicts basic functionality of application. The user requests and responses depicted by the transitions or edges that is the control flow of the web applications. When a user request the page, tha t is done by hit the hyperlink or clicking to submit a form, the server produces a view of the application that is depicted by a node.

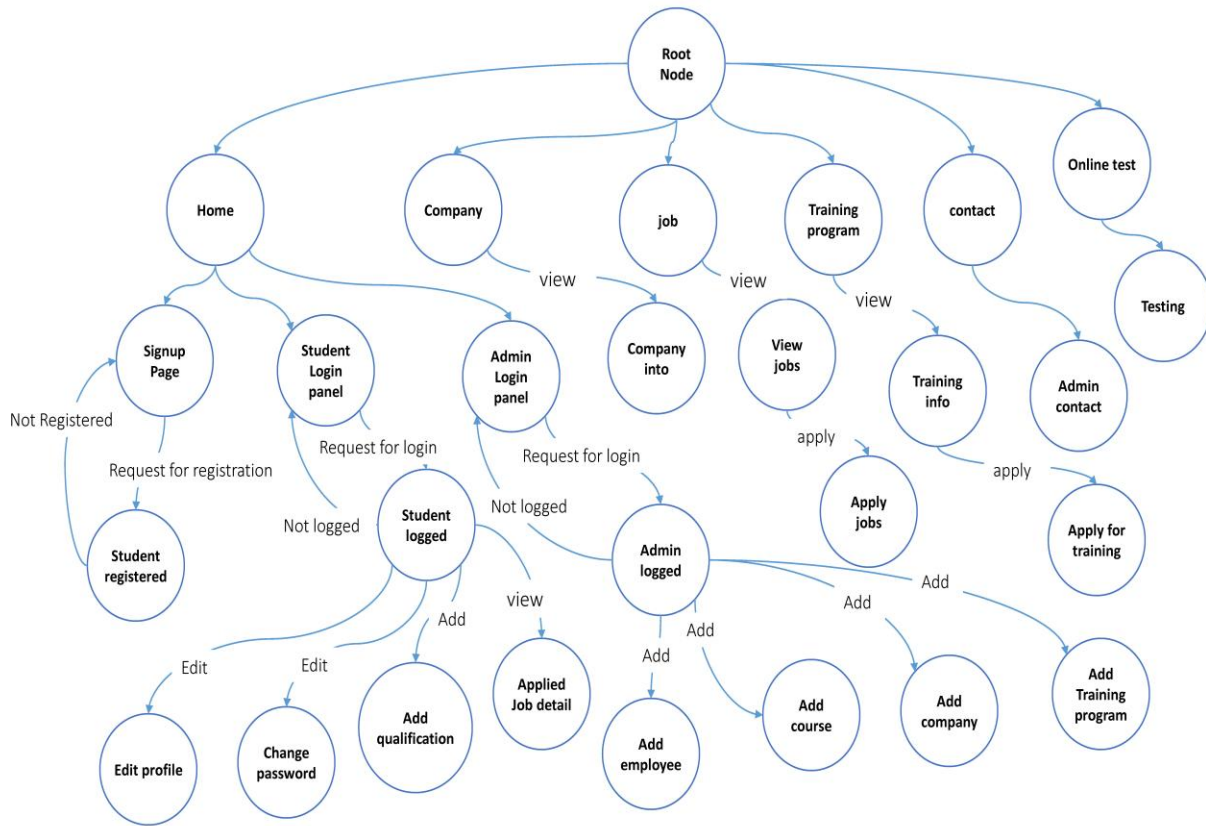


Fig. 1 Workflow Model for Online Career Guidance System

Test case generation approach

We proposed test case generation approach from workflow model using UML Activity Diagram that is used for modeling system functionality for test case generation. To represent the system dynamic behavior UML Activity diagram is used. In UML activity diagram flows from one activity to other represents the operation [9]. Activity diagram is likely to be a directed graph consists on nodes and edges. A flow of activity diagram is described as an ordering / sequence of edges start from the root node of the activity diagram to the target node, the node without any leaf node. First of all using the model we create an activity diagram, secondly create activity flows and thirdly then generate test case.

To illustrate our proposed approach, web based application “Online Career Guidance System” is taken as case study: “Online Career Guidance System is an online recruitment web based project. This project / website is about for hiring persons for jobs and also it provides a facility to taking online exam / test for this job on a candidate apply. In this website the user is able to make online CV and when his CV match with job post from database then automatic Email will be sent to candidate for online testing. After that he can also attempt online test for this job. If test is passed he will be able to proceed further for interview and received a conformation email. If failed then sorry Email will be sent to candidate. This confirms the manager will benefit from reduced time to hire, cost per hire, enhanced applicant communications with too much less effort and enhanced

employer branding. If an employer hires 25 staff or more than 25 in a year, employer will find out that the Online Recruitment System will provide with the latest functionality. Online Career Guidance System consist of different components / pages. However, there is taken some main components / pages as case studies”

Here we discuss the main components / modules of the website for illustration of proposed approach. There is an activity diagram of Student Registration at “Online Career Guidance System” (OCGS) that shows the graphically control flow how a student can registered at OCGS.

The above activity diagram shows flow control of the student can register at “Online Career Guidance System” (OCGS). If any student want to sign in he enter user name, if that user is correct

The following table 1 shows the activity flows (that is the student registration process from one activity to another activity) created from the activity diagram:

These flow will help to understand the basic flow of activity and sequence of activities in well manner. We represent flow ID’s with the name of F1, F2, F3 and so on. In F1 we want to register a member is he already cannot register. If he is already register then he can enter registration No. and user name for course registration. If not registered then automatically shift to new registration link. In F2 show sign up page for registration of new user at website. The three scenarios are discussed from the above mentioned case study for example discussion. “Online Career Guidance System” (OCGS) use as case study for student registration system.

The following table 3 depicts the test cases generated from the activity flow. As we have describes the test case in introduction.

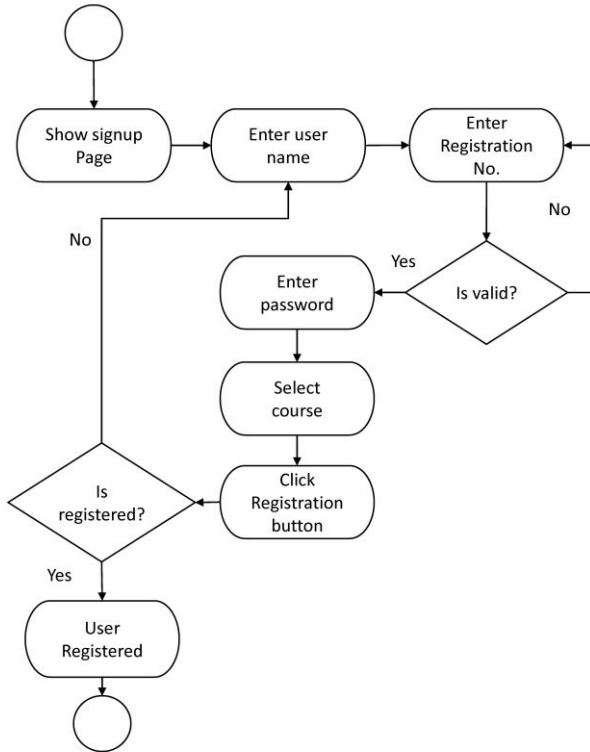


Fig. 2 Activity Diagram (Student Registration)

Table 1. Activity Flows of Student Registration

Flow ID	Activity flow
F1	Start→ show sing up page→ enter user name →enter registration no.→ is valid?→ enter password → select course→ click registration button→ is registered?→ user successfully registered → closed
F2	Start→ show sing up page→ enter user name →enter registration no.→ is valid?→ enter registration no.
F3	Start→ show sing up page→ enter user name →enter registration no.→ is valid → enter password → select course→ click registration button→ is registered? → enter user name.

IV. RESULTS AND DISCUSSION

Dataset

Our work is based on test case generation of web applications. So in data set we use the source of our data are websites like Online Admission System, Online Examination System, Student information System, Library Management System etc. but we use website “Online Career Guidance System” (OCGS).

All possible test cases generated by the approach for student registration are given below and furthermore, all the possible test cases assumed for all module of the case study are also mentioned in the table:

Table II. Test cases for case study

Modules	Total Test Case	Negative Test Case	Positive Test Case
Module 1	3	2	1
Module 2	5	3	2
Module 3	10	6	4
Module 4	6	5	1
Module 5	9	6	3

V. CONCLUSION AND FUTURE WORK

Recently, web applications are mostly use as information systems in every organizations. These application systems are necessary to test. Web application testing is interesting not only in functional testing but also in nonfunctional testing such as security and reliability. Web application’s testing is very important for the production of the quality. In this paper we proposed a workflow model that covers the information and the behavior about the web application structure. The model has different features like structure of web application, flow of data and workflows etc. With the help of workflow model we generate the test cases using UML Activity Diagram that is used for modeling system functionality. Proposed approach is demonstrated by mean of case study “Online Career Guidance System”. In future work we will propose a hybrid test case prioritization techinque to test web applications that will helpful for software developers, testers and quality.

Table III. Test case generation for student registration

Activity Flow	Data set	Test steps	Expected output
<ul style="list-style-type: none"> • <u>F1</u> • Start • Show sign up page • Enter user name • Enter registration no. • Is valid? • Enter password • Select course • Click registration button • Is registered? • User successfully registered • Closed 	<p>Valid student information (registration no. & password)</p>	<p>Request for registration form</p> <p>Enter student information</p>	<p>Student successfully registered</p>
<ul style="list-style-type: none"> • <u>F2</u> • Start • Show sign up page • Enter user name • Enter registration no. • Is valid? 	<p>Invalid student registration no.</p>	<p>Request for registration form</p> <p>Enter student information</p>	<p>An error message displayed and student is not registered</p>
<ul style="list-style-type: none"> • <u>F3</u> • Start • Show sign up page • Enter user name • Enter registration no. • Is valid? • Enter password • Select course • Click registration button • Is registered? • Enter user name 	<p>Any field miss or invalid</p>	<p>Request for registration form</p> <p>Enter student information</p>	<p>An error message displayed that point out the column for fill out</p>

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