RESEARCH ARTICLE   OPEN ACCESS

A Survey on CMMI Level 5 Companies Using Selenium Testing Technology

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ABSTRACT
An automation testing can play an important role to ensure quality of the web application software. Selenium is an automation open source testing tool used to test the web application by using Java language. Moreover selenium supports multiple programming languages except C and C++. In selenium standalone applications are automated by using AutoIT tool. In this paper mainly used to analyze various CMMI level 5 companies using selenium testing technology to execute the test script of the related software applications to identify an error/bug in order to increase the performance of the software. The objective of the paper is to present a number of familiar web application projects tested by using selenium in different CMMI level 5 companies in order to provide researches proudly shared about executing of selenium testing technology.

Keyword- Automation testing tool, CMMI level 5 companies, Error/Bug, Introduction Auto IT tool, Selenium tool, Standalone application, Test script, Web application

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I. INTRODUCTION

Selenium is a set of various software tools each with a different approach to supporting test automation. Most selenium test engineers concentrate on the one or two tools that most meet the needs of their projects. The entire Selenium process of tools results in a effective set of testing functions specifically encouraged to the needs of testing of all types of web applications. One of the key features of selenium is the support for executing one's tests on multiple browser platforms.

The rest of the paper formulates following information. Section II describes background, Section III represents mechanisms and technology supported by Selenium, section IV explains the comparison of Survey of various CMMI Level 5 companies' selenium testing technology and finally section V concludes this survey paper.

II. BACKGROUND

1. Programming Language

Selenium automation testing tool using all object oriented programming language such as Java, Python, Perl, Ruby, PHP, .Net…etc, except C and C++.

2. Selenium versions and Tools

Many QA (Quality Assurance) gets started with selenium IDE (Integrated Development Environment). If test engineers are not already started with a programming knowledge or scripting language, they can use the selenium IDE to get familiar with selenium commands.

Selenium IDE can be developed into 3 versions of the selenium tool as follows.

1. Selenium Remote control 1.0
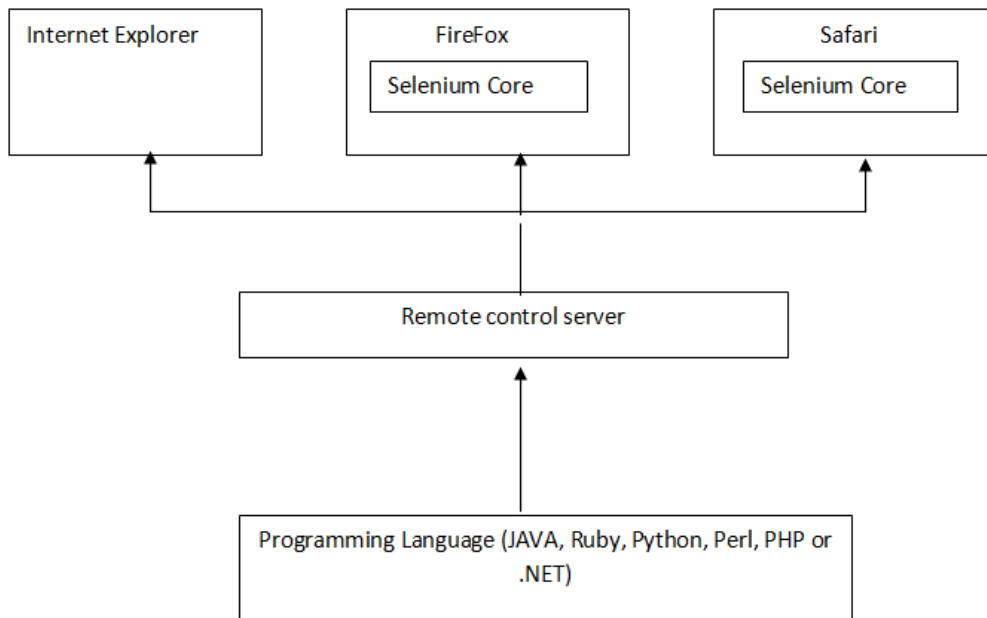2. Selenium Web driver 2.0
3. Selenium Grid 3.0

2.1 Selenium Remote Control 1.0

Selenium Remote Control (RC) is an automation test tool that allows us to write automated web application UI tests in any programming language except C and C++, against any HTTP website using any mainstream Java script-enabled browser.

Selenium Remote control can be classified into two parts

(i)   A server which automatically launches and kills browsers and act as an HTTP proxy for web requires from browsers

(ii)   Choose client libraries for our known computer language

Architecture representation of selenium remote control as follows

Then test the software application in Selenium IDE is more expressive programming language than PHP and HTML .

Selenium Web Driver 2.0 is an integration of selenium 1.0 and web driver. Then the web driver fits in the same role as remote controller did and it refers to both the language and implementations of individual browser controlling code.

2.2 Selenium Web Driver 2.0

Web Driver is a compact object oriented Application Programming Interface when compared to Selenium 1.0.

Web Driver overcomes the limitations of Selenium RC's and it is designed in a simple manner and more concise programming interface along with limitations in the Selenium RC API. Selenium Web Driver, we can easily download the JAR file and add it into the eclipse because it is an open source testing tool.

The following diagram explains Web Driver 2.0 architecture
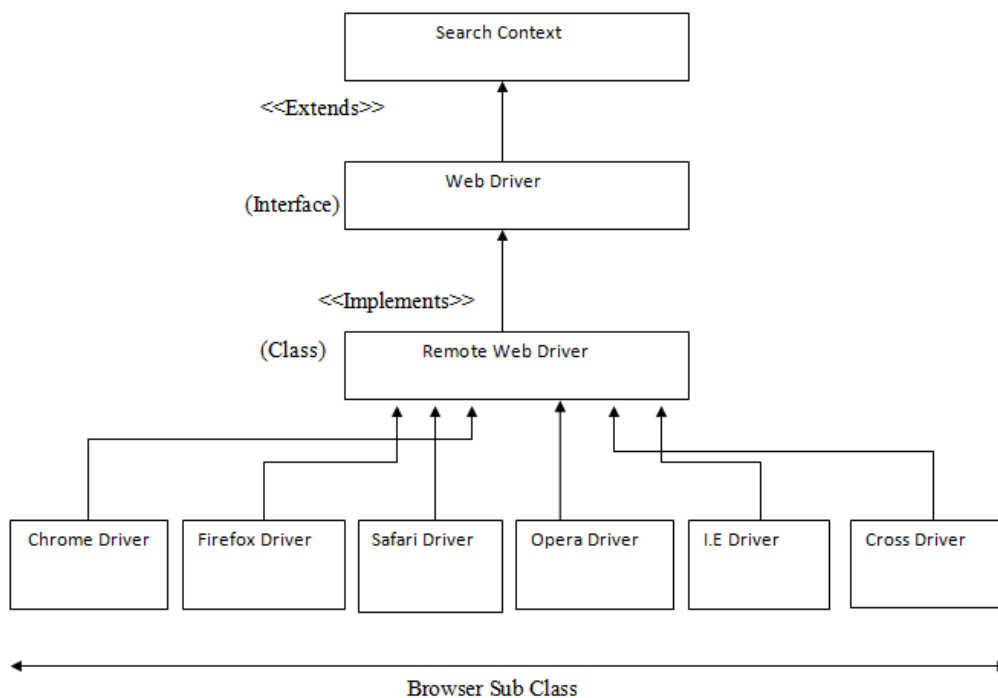
Advantages of Selenium Web Driver 2.0:

a. Selenium is able to run under multiple browsers such as Firefox, Opera, and Internet Explorer etc.
b. It is an open source and free download
c. Although selenium has its own scripting language and it can work with language binding to support whatever our test engineers are comfortable with including C#, Java, Java Script, PHP, Python.
d. Selenium does not restrict QA's choice of reporting tools.
e. It is also supported web applications that apply part of their functionality within the browser using AJAX and Java Script technologies.

Limitations of Web Driver 2.0

a. It is not automate standalone application

b. By using Selenium, you are not able to minimize the browser
c. Selenium doesn't support new tab

2.3 Selenium GRID 3.0

Selenium GRID 3.0 is a network that has different versions of browsers installed and the network is efficient enough to delegate script executor to the node that has the requested browser configuration.

Selenium GRID creates HTTP network servers which are having two major roles such as Hub, Node. If the GRID has a node that matches the browser configuration requested in the payload, the Hub establishes a session and the script commands execute on that browser. If there is no match, then Hub returns an error.

The following diagram explains Selenium GRID 3.0 architecture

The following diagram explains Selenium   GRID 3.0 architecture
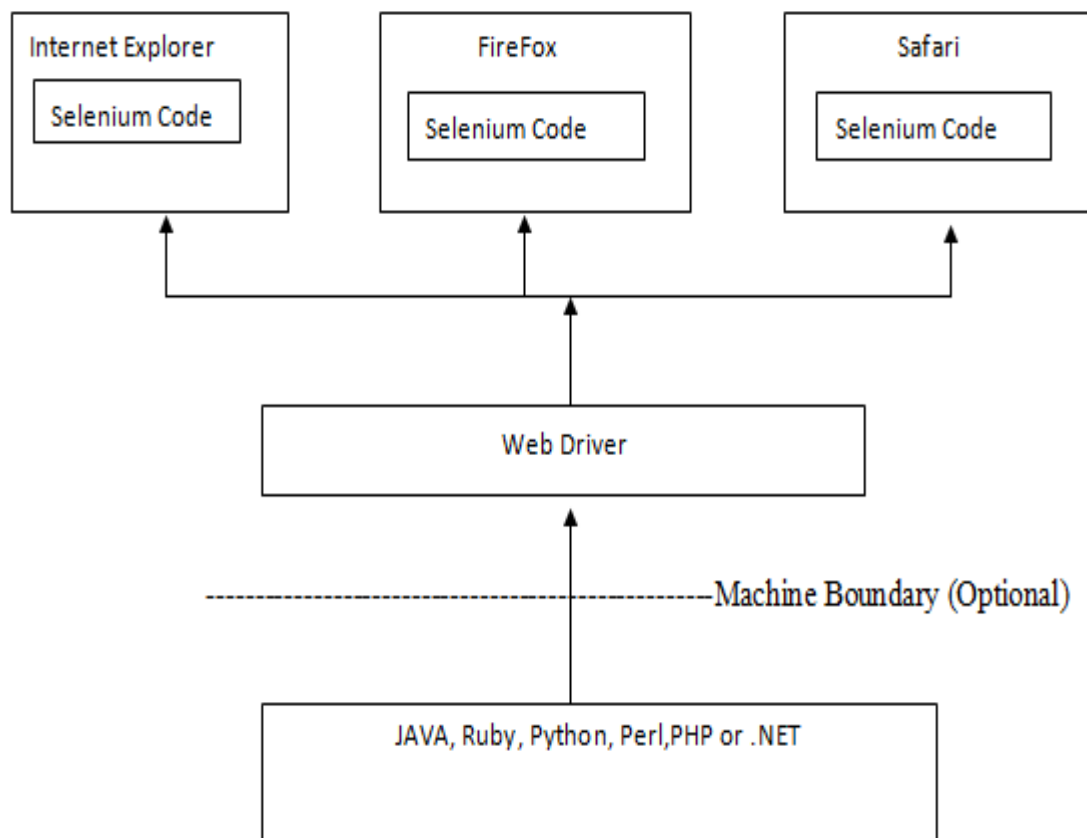
The workflow of architecture is our code (Java, .Net, Perl, Python, Ruby…) communicates with Selenium Web Driver or the browser specific client driver that acts as HTTP proxy. Example: FirefoxDriver.exe, ChromeDriver.exe, IEDriverServer.exe, SafariDriver.exe. Then session is created and then the HTTP request and response communication happens.

III. MECHANISMS AND TECHNOLOGY SUPPORTED BY SELENIUM

The Selenium automation tool is providing a framework and gives the compatibility about how to perform file handling, Excel sheet handling, Pop up handling, Taking a screen shot from application flow.

This section brief discussion about frameworks of selenium, which is used by CMMI level 5 companies and handling web application tasks as follows.

1. **File Handling**
   Selenium Web Driver handling .txt and .doc files in an effective manner. It gives information about how to create, Write, Delete and Read from or to files. The following code represents handling of .txt and .doc file in selenium using Java language.

2. **Excel sheet Handling**
Selenium tool is handling of excel sheet effectively through read, Write and updating data. The following code formulates how to handle excel sheet using Selenium tool. The following code represents how to handle excel sheet.

3. Popup Handling
Here we explain how to handle popup messages in web application using selenium tool. Pop ups are classified into 7 types based on their characters.

1. Alert and Confirmation Pop up
2. Hidden division Pop up
3. Child browser Pop up
4. File upload Pop up
5. File download Pop up
6. Page on load Pop up
7. Window Pop up

3.1 Characteristics of Alert and confirmation Pop up
 i) We can move the pop up
 ii) We can't inspect the pop up
iii) It may have ok button or both ok and cancel button

3.2 Characteristics of Hidden division Pop up
i) Hidden division pop up is the part of our web page
ii) We can't move the pop up, but we can inspect the pop up
iii) Most of the cases the pop up is having some unique colors compare to other pop ups.

3.3 Characteristics of child browser pop up

It is a new window which is opened by clicking on the link present in the browser which is opened by selenium

3.4 Characteristics of file upload pop up
i) It will have browser button or some other buttons which are used to choose the file from our local machine.
ii) We click on the browser button, the pop up will appear with the name file upload.

3.5 Characteristics of file download pop up
i) This pop up will appear while downloading the files
ii) This pop up may contain 2 radio buttons, 1 check box and ok, cancel buttons, but in some pop ups we will have only save file and cancel button
iii) There is no solution in Selenium to handle file download pop up. So we have to use the help of third party tools.

3.6 Characteristics of Page on load Pop up
i) This pop up will appear while your browser is on load. Hence it is called as a page on load pop up
ii) We can't handle this pop up, because selenium will not do any action on the browser "If the browser is loading".

3.7 Characteristics of window pop up
i) If the pop up is not matched with any of the pop up's characters, then it is called as window pop up.
ii) We have to handle this pop up only with the help of third party tool.

4. Handling Screenshot
Here, how to take a screenshot through Selenium using Java. The following code formulates, taking a screenshot using selenium Web Driver 2.0.

6. Handling Drag and Drop
To achieve drag and drop, we have to use the non-static method dragAndDrop() and this method present inside a class called "Actions".

Frameworks
The critical software contains rigorous functional tests, especially supported by automated testing frameworks. Automating these frameworks and maintaining quality software tool business performance.

By implementing the approximate automated testing frameworks significantly increase the speed and accuracy of the testing process and give a Return on Investment (ROI) from software project and significantly minimized risk.

The familiar frameworks are used by CMMI level 5 companies as follows.

 i. Page object model
 ii. TestNG framework
 iii. Keyword driven
 iv. Data driven
 v. Modular driven
 vi. Hybrid driven

6.1 Page Object Model (POM)

POM is an important framework in Selenium, which contains lots of rules as follows.

a.   We have to create a normal Java class, but the class name should be similar to the title of the page and the class name should end with the word page to make the normal Java class as POM class.
b.   Inside POM class we have to create data members, function members and constructors
c.   Inside POM class static methods are not allowed
d.   Inside POM class all the data members (Variables) are private and non static and these data members are used to store the address of the web elements which are present in the particular web page.
e.   We have to create a public constructor inside the POM class which is taking Web Driver as an argument.
f.   Only inside the constructor we have to utilize data members.
g.   Inside POM class we have to create only non static function members (methods) and these members function names are similar to the action what we are performing on that page.
h.   Inside POM class main method is not allowed. So to execute the POM class, we have to create a main class which contains main method and the main class name can be main or base or application name.

6.2 TestNG Framework

TestNG is a unit testing framework. Generally used by the developers for doing unit testing or white box testing. The test method is the non static method which is present under, @Test annotation is called as Test method. TestNG framework is Selenium , which contains lots of rules as follows.

a.   Inside the TestNG class, static methods are not allowed and all the non static methods should present under any one of the TestNG annotations.
b.   No need to create object for calling these non static methods because everything is taken care by the annotations
c.   Test method present in TestNG class will act as a main method
d.   Inside TestNG class all methods are present under any one TestNG annotations
e.   Multiple main methods are allowed in the TestNG.

6.3 Keyword Driven Framework

Keyword Driven Framework is a best example of functional automation framework which is used to divide the test cases into four types as follows.

1.   Test Step
2.   Object of Test Step
3.   Action on Test Object
4.   Data for Test Object.

The main idea of keyword driven framework is nothing but separate the code from test case. It gives regular changes and updates of background automation code.

6.4 Data driven Framework

Most commercial automated software tools on the market to support some sort of data driven testing, which allows you to automatically run a test case multiple times with different input and validation values. As Selenium WebDriver is more an automated testing framework than a ready-to-use tool, you will have to put in some effort to support data driven testing in your automated tests. we usually prefer to use Microsoft Excel as the format for storing my parameters. The following rules will give the information about handling data driven framework.

1) Download JAR files of Apache POI and Add Jars to your project library. You can download it from here. That's all about configuration of Apache POI with eclipse. Now you are ready to write your test.
2) Create a '**New** Package' file and name it as 'Test Data', by right click on the Project and select New > Package. Place all of your test data in this folder (package) whether it is a SQL file, excel file or anything. The following rules will give the information about handling data driven framework.
3) Place an Excel file in the above created package location and save it as TestData.xlsx.
4) Add two constant variables (testData package path & Excel file name) in the Constant class.
6) Once we are done with writing Excel functions we can go ahead and modify the SignIn_Action module to accept the test data from an excel file.
7) Create a 'New Class' and name it as Apache_POI_TC by right click on the 'automationFramework' Package and select New > Class. In this we will read the values from the Excel sheet to use them as the test data and write the test result in the Excel.
8) Once it finished open the Excel file and check for the result.

6.5 Modular driven Framework

In most of the web application we have a few set of actions which are always executed in the series of actions. Rather than writing those actions again and again in our test, we can club those actions into a method and then calling that method in our test script. Modularity avoids duplicity of code.

1) Create a 'New Package' file and name it as 'appModule', by right click on the Project and select New > Package. We will be creating different

packages for Page Objects, Utilities, Test Data, Test Cases and Modular actions. It is always recommended to use this structure, as it is easy to understand, easy to use and easy to maintain.

2) Create 'New Class' and name it as SignIn_Action by right click on package **'appModule'** and select New > Class. It will add new class 'SignIn_Action' under package 'appModule'.

3) Now create a Public Static Void Method and name it as Execute and club the following steps in to it:

- Click on the My Account link.
- Enter Username
- Enter Password
- Click on the Submit button

This method will not have any Argument (driver) and Return value as it is a **void** method.

4) Create a New Class and name it as Module_TC by right click on the **'automationFramework'** Package and select New > Class. We will be creating all our test cases under this package. Now convert your old POM_TC in to the new Module based test case.

6.6 Hybrid Driven Framework

This framework is at a very beginner level and very easy to understand. This implements the Page Object Model Technique, Data Driven Technique, Modular Driven Technique, Log4j Logging, TestNG Reporting & TestNG Reporter Logs.

IV COMPARISON OF SURVEY OF VARIOUS CMMI LEVEL 5 COMPANIES' SELENIUM TESTING TECHNOLOGY

Here we must compare all the CMMI level 5 companies Selenium tests technology and then proceed to examine the software quality. The following table summarizes the Selenium testing technology version, programming language, success rate about CMMI level 5 companies.

S.NO	Company Name	CMMI Level	Project/Application	Selenium Version	Frameworks	Programming Language	Success Rate	Operating System	Browser
1	Infosys	5	Banking Project	Selenium 3.0.0	WebDriver, Data Driver Frame Work	JAVA	High	Windows 7	IE
2	Infosys	5	Health Care Projects	Selenium 3.0.1	WebDriver, POM framework	JAVA	Medium	Windows 7	IE
3	Infosys	5	Banking Project(Middle Ware)	Selenium 3.0.4	TestNG, AutoGEN	JAVA		Windows 7	IE
4	Infosys	5	Airlines Projects	Selenium 3.0.0	Cucumber	Python	High	Windows 7	IE
5	Infosys	5	Tele-Communications	Selenium 3.0.0	Cucumber with TestNG	JAVA	Low.(Due to Project migration Automation was not achieved as expected level)	Windows 7	IE
6	HCL	5	Telecom Project	Selenium 3.0.6	AutoGEN	JAVA	Medium	Windows 7	IE
7	HCL	5	Networking Project	Selenium 3.0.0	Keyword Driven	JAVA	Medium	Windows 7	IE
8	Capgemini	5	Banking Project	Selenium 2.53.4	TestNG	JAVA	High	Windows 7	IE
9	CTS	5	Airlines Projects	Selenium 3.0.0 above	WebDriver, Data Driver Frame Work	C#.net	High	Windows 7	IE
10	TCS	5	Government Projects	Selenium 3.0.0 above	WebDriver, Keyword Driven Frame Work	C#.net	High	Windows 7	IE
11	TCS	5	Government Defence Projects	Selenium 3.0.0 above	WebDriver, Data Driver Frame Work	C#.net	Medium	Windows XP SP2	IE
12	TCS	5	Energy and Resources	Selenium 3.0.0 above	TestNG	JAVA	High	Windows 7	IE
13	Accenture	5	Insurance	Selenium 3.0.0 above	Cucumber	Python	High	Windows 7	IE

14	CTS	5	Bank Loans Projects	Selenium 3.0.0 above	TestNG	JAVA	High	Windows 7	IE
15	Hexaware	5	CMI (Communication, Media & Information Industries	Selenium 3.0.0 above	WebDriver, Data Driver Frame Work	C#.net	Medium	Windows 7	IE
16	AON Hewitt	5	Manufacturing Project	Selenium 3.0.0 above	Cucumber	Python	High	Windows 7	IE
17	Tech Mahindra	5	Travel and Utilitties\	Selenium 3.0.0 above	TestNG	JAVA	Medium	Windows 7	IE
18	Wipro	5	CPG	Selenium 3.0.0 above	WebDriver, Data Driver Frame Work	C#.net	Medium	Windows 7	IE

V CONCLUSION

Our proposed a scheme survey on CMMI level 5 companies using Selenium testing technology. This paper mainly used to compare CMMI level 5 software companies' success rate, open source framework, object oriented language, browsers, effective test execution done by test engineers. This survey scheme is used to select suitable testing frameworks in Selenium to increase the quality of the end software product.

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