Comparative Study of Software Automation Tools: Selenium and Quick Test Professional

Sana Fatima  
Department of Software Engineering  
NED University of Engineering & Technology,  
Karachi, Pakistan  
sanafatima@cloud.neduet.edu.pk

S. Faiza Nasim  
Department of CS & IT,  
NED University of Engineering & Technology,  
Karachi, Pakistan  
sfaizaadnan@gmail.com

Najmi Ghani Haider  
Department of Computing Sciences (CS)  
UIT University,  
Karachi, Pakistan  
ghaider@uit.edu.pk

Mubeen Rasheed  
Department of Software Engineering  
NED University of Engineering & Technology,  
Karachi, Pakistan  
mubeenrasheed001@gmail.com

Zoha Akram  
Department of Software Engineering,  
NED University of Engineering & Technology,  
Karachi, Pakistan  
zoha.ak24@gmail.com

Abstract— In today’s challenging world software testing is a very crucial part of the software development lifecycle (SDLC) as it helps in minimizing errors, and reduces maintenance and cost of the software. This work aims to analyze the various tools presently available for software automation. The selection of productive testing tools plays a vital role in the implementation of software products with high quality and it also ensures premium quality throughout the SDLC. One of the key issues is the selection of adequate software testing tools and frameworks. This paper discusses Quick Test Professional (QTP) and Selenium on the basis of various attributes which include Source and Licensing, Testing Cost, Object Repository, Usability, and programming language support. The use of an adequate automated software tool provides ease in testing and allows the tester to execute test cases in an efficient manner by overcoming the challenges such as limited time, increased pressure and minimum resources.


I. INTRODUCTION

Nowadays more or less all big business concerns are shifting towards automation. Software testing is fundamentally the evaluation of the software under the software development lifecycle. It is conducted in order to enhance the quality of the software and for the verification of user requirements. There are two ways to perform the testing, i.e. manual testing and automated testing. Manual testing, which is also known as static testing, is done manually by the software testers to weed out errors. The tester acts as an end-user to know the behavior and ensure all requirements are met properly by using all of the features of the software, thus this approach takes a lot of time and is not cost-effective at all. Automation testing is also referred to as dynamic testing. Automation testing is significantly better than manual testing for a number of reasons, such as it provides earlier recognition of bugs, saves cost, consumes less time, gives higher efficiency, accuracy, reliability, and enhances test cases and coverage. Automation testing is not appropriate for all domains. It is best suited for regression, data-driven, static, repetitive, smoke, load, and performance testing [1]. In other words, automation testing can be used as an effective tool for functional and non-functional types of tests. One of the biggest challenges is to find an appropriate automated testing tool to guarantee the success of the software project to be tested. The main factor for deciding which automation tool to use is the software budget as there are both free and paid automated testing tools available in the market as well as the nature of the application to be tested. The two tools that are predominantly used are Selenium and QTP. Selenium does not require the purchase of any license as it is Open Source and hence it is very much preferred by the Quality Assurance teams when we have a low budget. It is based on Java Scripting and one of its important features is the support for multiple browsers. Selenium is largely used to do automation testing for web applications. On the other hand, HP owns QTP, also known as UFT, is proprietary which means a license needs to be purchased in order to make use of all the
features provisioned in this tool. Figure 1 (below) shows the test cycle under QTP testing.

![Fig. 1. QTP Test Cycle [26]](image)

The scripting efforts are more for Selenium than for QTP. QTP provides data-driven testing and thus minimizes the repetition of test cases and is largely used for functional testing as it is very much user friendly. In this study, we compare the two testing tools namely Selenium and QTP based on certain factors. This paper is based on a comparison of above mentioned widely used software automation tools[12][14] in such a way that it covers both theoretical view and technical tradeoff as well as it also includes pricing so that anyone will be able to choose one of the tools according to his needs which was not covered before. Furthermore, a decision can also be made based on technical knowledge of developers.

II. LITERATURE REVIEW

Ateşoğulları [1] states the significance of software testing and how it is carried out. Also, it provides a comparison between manual testing and automation testing and the impact of factors such as budget, and nature of software being developed. Further, it discusses the automation testing tools such as Selenium, Protractor, Watir, Appium, and several others, and automation testing frameworks which include hybrid testing framework, keyword-driven testing, modular testing, and behavior testing framework. Karthik [2] refers to how automation testing has made testing easy for the software testers and that automation tools both can be free and paid/licensed or unlicensed. In addition to this, it has laid down the benefits and drawbacks of using Selenium and UFT (Unified Functional Testing/QTP (Quick Test Professional) and all the major differences between them that make it easy for the tester to select which tool best suits the need. Prachi [3] declares that there are several objectives of doing testing but the primary goals are to find and fix goals. This research paper gives an evaluation of different testing tools based on some identified parameters. It also provides knowledge about different automation tools and frameworks and how evaluation is done on the basis of parameters such as browser support, scripting language, operating system support, besides others. Lastly, it also highlights when to use and prefer Selenium and UFT. Bharti [4] gives a thorough discussion of the purpose of testing and the contrast between automation and manual testing and cover all features of all the three testing tools, i.e. Selenium, QTP, and Test Complete. Moreover, the research covers a vast range of automated testing tools that are readily present in the market [5]. The research provides a comparative analysis of Selenium, QTP/UFT, Test Complete, Ranorex, and Load Runner on the basis of software support, cost, testing, licensing, testing etc. Based on different evaluation parameters, it also provides an overall review by comparing the mentioned automated software testing tools. Thus, it explains why testing is very essential and gives a detailed overview of Selenium and Sahi [6]. It also covers the details of the parameters on the basis of which we choose testing tools and what each of the parameters involves in testing. Not only has this but it also mentioned the comparative analysis of Selenium and Sahi based on all these features. Lastly, it also states the step-by-step complete description of how testing is done using selenium. It covers all aspects of testing like why it is important when it should be done, and the set of activities it involves [7]. The pros and cons of manual testing and automated testing are also covered here. In addition to this, it mentions different criteria for the selection of all the several testing tools mentioned in this study and which testing tool should be used for which type of testing. The most popular automated testing tools like Selenium, QTP, Test Complete and SoapUI are compared in [8], and it concludes that Selenium is good for cheaper testing as it is free, but it requires more scripting. It is also said that scripting in Selenium is 15% higher than that in HP QTP. HP QTP is more expensive but it is good for applications where data security is a major need. It depends on users’ need to select which is the best-automated testing tool. Kaur et al. [9] draws conclusion by comparing the above mentioned tool on the basis of efficiency, cost and the type of application that needs to be tested. According to the authors, QTP is the best testing tool if the budget is not tight. A new concept of testing was proposed in [10]. The goal of an automation testing technique is to help with software programmed application testing. From HP-QTP through Selenium, there were various web automation tools available. Before deciding on a tool, testers must weigh the pros and cons [11]. A new automated testing framework is presented that provides more assistance to testers throughout the software automation testing process. The SAT framework that has been proposed can be used to automate the process of writing test scripts. These experiments have yielded encouraging results.
demonstrating that it can save roughly 68% of total work and hence reduce the product launch cycle. This groundwork by Hanna [12] has circulated more than 130 tools across more than 5 types of applications. There is no system, acceptability, unit, functional, or regression testing tool for network software products (TCP protocol). This classification indicates which type of testing has automated technologies that are limited. The best strategy to improve the efficiency of software testing was illustrated in [13] to specify which tool is the best to use for automated software testing. Selenium is a web application testing framework that includes a number of tools. Test cases are automatically captured in the background as the tester enters data into a web screen using this method. Tools that are provided in Selenium testing give a rich set of testing methods explicitly intended to satisfy the necessities of testing of a web application [14]. In a very short period of time, automation in testing of web applications through Selenium is gaining much popularity. Nowadays it is the first preference of every tester requiring automation in web testing because it is much more flexible and extensible. It is an open-source as well as only a web-based app automation testing tool [15]. Additionally, it comprises of type of testing tool and framework that should be preferred for software testing while considering different factors that might affect the software quality. Automated testing yields improved efficacy of software up to one more high scale [16]. Using tools such as Selenium, Sikuli, etc. automation testing automates the writing and executing of test cases where multiple test cases are grouped in a test suite. Hybrid automation tool uses both Selenium and Sikuli for automating the test cases in order to overcome the constraints of using Selenium and Sikuli individually alone. The overall architecture and complete implementation of this hybrid scripting are discussed in this paper. A comparison with all previous research has also been given. Both Selenium and Sikuli are free tools that detect errors in real-time. The integration of these two tools allows automating nearly all possible scenarios except a very few. A comparison among several off-the-shelf available testing tools is shown in [17]. It discusses the importance of testing web and mobile applications that involve network connectivity. The selection of testing that is to be done manually or with automated tool totally depends upon project requirement, budget associated with project and also which testing is benefited to the project [18]. Automated testing allows testing applications in a fast and efficient manner with reduced cost. It is stated that if the budget is tight, Selenium is preferred over quick test professionals for functional testing. Load Runner plays a key role in testing the performance and efficiency of applications. Automation tools are used to automate certain sections of manual testing but not use to automate all parts of software [19].

III. METHODOLOGY

This study researches the various types of automated testing tools that presently exist in the market. Different tools are available for multiple platforms and some of them are open source, but the main comparison related to automation testing is done on the basis of the description of details written in their respective documentation. In this study, Selenium and QTP are selected and both perform automated testing on the basis of record scripts and those scripts can be played and tested again and again which is an important feature in automated testing. Automation in testing is a sort of testing process in which different data sets are given to testing software that runs these different data sets on a given task repeatedly without even the interference of humans. Basically, the main purpose of automation is to reduce human effort or interaction in those tasks which are redundant. Automation in testing attempts to solve all problems of manual testing by different tools of automation, and hence by using those tools speed of testing increases. Developers find it tough to test the performance of software for them because simultaneously they have to develop a module and test it. Here, an automated testing tool provides different ways to solve these kinds of problems up to some extent.

There are mainly two types of automated software in the market:

a) Open Source
b) Commercial software

Open source tools are easily available in the market and are free of cost, and due to this reason they have a bigger community of users, while commercial tools have to be purchased, and can be obtained from their official websites, and users have to buy their licenses by selecting a plan according to their needs.

A. Quick Test Professional

QTP is a type of automated software testing tool which provides an interface graphically and it also provides a feature to record and then play back. Multiple types of regression and functional testing can be performed through it for different applications. It uses the VB scripting language for writing test cases and procedures as well as to manage the app during testing and further to control objects of app which are under testing. QTP can also test non-browser applications like windows or desktop applications, but it only supports VB script. It can only be operated in windows and cannot be run or operated in other operating systems. It also gives support on the mobile platform through its commercial product Mobile Cloud for QTP. There are multiple frameworks also like HP ALM or HP quality
center so these can also be integrated with it. It provides an inbuilt object repository that can save different parameters of the object. On the other hand, it can also perform image testing in it. When the test cases and procedures are completed, reports are generated automatically which are easily available in its dashboards. Experience related to coding is not required in QTP because it provides a graphical interface so a person who has not much knowledge of coding can do testing in it. While it takes less time to test apps or to make test cases, more hardware resources are consumed here in the execution of scripts. As it is a paid product, so license along with maintenance is required purchasing annually.

B. Selenium

It is open-source but it only works for web platform applications on all browsers and it also supports various scripting as well as programming languages like Java, Python, PHP, and JS. It performs a functional type of testing of the web. It has four components. Firstly, the Firefox plugin is integrated in it as a development environment in Selenium. Now its first component is Selenium Remote which is used to manage tests in browsers where JavaScript language is supported, i.e., browsers compatible with JS. It noted that JS is approximately supported in each and every browser. The second component, WebDriver, was made to give more support to those websites which are dynamic (where content of website or web page changes without reloading) [20]. Selenium Grid gives the facility to execute test cases on multiple machines on different types of browsers. To perform automated testing in Selenium, a developer should have a specific set of skills related to programming languages. Selenium runs its test cases of all types of browsers in every environment like Windows, Linux, and Macintosh as shown in Figure 2 [20].

Different components of selenium are as follows:

- **Selenium IDE**
  It is an IDE which is a plugin in Firefox browser which allows users to record all actions which they perform on the web as they follow the flow of whole work which they have to perform to do a specific task. Firstly it records and then gives option to export a script which is reusable. It also provides an interface graphical via Firefox in order to use its recording feature. One of its good features is that the recorded scripts are able to be converted in multiple scripting or programming languages.

- **Selenium Remote Control**
  It is the type of tool for testing which gives the tester an opportunity to write test cases for automated UI tests in web applications. The best part is that the tester can write test cases in any language and that test case can run on any http web page. Its server has some sort of framework named Selenium Core which loads on the browser automatically. Selenium can perform recorded test cases in our desired language on multiple browsers at a time. It makes use of the full power of programming languages such as Java, C#, PHP, Python, Ruby, and PERL to create more complex tests [21]. Selenium Remote Control performs its testing in such a way that it makes its communication to the client's testing libraries to pass each command of Selenium to run.

- **WebDriver of Selenium**
  It takes over the selenium Remote Control (RC). It transfers its commands to browser directly and receives its results. Different frameworks are used by web driver. It does not make a contact with server or anything else otherwise it makes direct communication with browser without any interruption by a 3rd party.

- **Grid of Selenium**
  It is another tool providing facility of parallel testing like we can perform multiple tests on multiple machines and multiple browsers at a time due to which our execution time is reduced. It divides test cases on different machines so a script can be executed at a time which saves time to run those test cases. It makes more than one instance of Selenium RC and also web-driver and these all works on a single base of code; therefore, it is not needed that the code should be present on every system which is executing the code.

IV. DATA AND RESULTS

The data used in this paper is primarily based on survey discussed in [4][12]. With all these findings we can state that Selenium supports all common automation frameworks, such as linear, data-driven, keyword, hybrid, and so on. QTP provides good assistance as well
as a built-in dashboard for delivering test results to users. Quick test professional provides ease in learning [22] and it also possesses powerful backward compatibility as compared to Selenium. On the other hand, Selenium is an Apache 2.0 licensed open-source software testing framework. For authoring the test mean for online applications, it has a record/playback function. Selenium also has a multi-threading functionality that allows the script to be performed many times on various browsers, but Selenium being a web-based test language means it needs QA team members to have higher-level technical skills, such as programming. It doesn't have any built-in reporting or test management features. For comparing the two tools in terms of different parameters on a 3-Level scale: Good, Average, and Bad (1,2,3) respectively on the Y-axis, we have designed a graph which shows a comparison of a number of parameters on a scale of the points mentioned above.

Figure 3. QTP & Selenium – An Analysis

Figure 3 shows a comparison of Selenium and QTP on the specific parameters. The result shows that no solid probability of result is obtained which can show that one tool is better than the other in every aspect. Both tools have their advantages and deficiencies. If Selenium is better in one parameter, then it is not necessary that it would be better on the other parameters as well. Although QTP is expensive but its execution speed is better than that of Selenium. In terms of generating scripting language, it can be seen that Selenium is better than QTP in such a way that Selenium supports a number of programming languages because it is designed for completely technical users, whereas QTP only supports VB script. The aforementioned statement also clarifies the difference in “Ease of Use” as Selenium is hard to use compared with QTP as technical capabilities of different frameworks integrating is also required in this. However, if efforts regarding scripting are considered, QTP is better as Selenium is more for heavy programs and requires good technical knowledge, whereas QTP is a tool where the efforts for scripting are decreased in about more than 15% as compared with Selenium.

In short, the time for creating a script in selenium is higher than in QTP. For reports, which is one of the major concerns for testers in software houses, in order to record the result, Selenium does not have its own tool for generating reports however it can be integrated with other tools like Jenkins to create dashboards and generate good reports. In contrast to this, QTP is better as it assists us through its tool called Quality Center which is in-built tool and creates better dashboards and reports. Some quantitative comparisons with respect to the usage of these two tools are now presented.
Fig. 4. Usage of Selenium [23]

Fig. 5. Usage of QTP [24]
The graph in Figure 4 illustrates the usage of Selenium by companies distributed in terms of country [23]. Figure 5, Illustrates the usage of Quick Test Professional by companies distributed in terms of country [24].

The biggest difference between these two automation tools can be clearly seen with the help of the Pie-chart in Figure 6. Selenium is highly used as compared to any other automation tool and if QTP is concerned it shows a difference of almost 19% [23, 24].

The biggest difference between these two automation tools can be clearly seen with the help of the Pie-chart in Figure 6. Selenium is highly used as compared to any other automation tool and if QTP is concerned it shows a difference of almost 19% [23, 24].

V. DISCUSSION

Manual testing of computer applications requires a lot of time and resources. Hence, automated testing comes into play to lessen the burden or even eliminate the requirement for manual testing to the fullest extent. There are several open-source tools available to perform automated testing.

A few of the mainly dominating ones are Selenium and Quick Test Professional (QTP).

For this comparative study, the latest versions of Selenium i.e. 4.0.0 Alpha 5, and Quick Test. Professional / Unified Functional Testing (UFT) i.e. 14.03 were used.

In Table 1, Selenium and Quick Test Professional (QTP) are compared on a number of different parameters such as cost, supporting platforms, programming language support, sources and licensing, area of actions, resource consumption, usability, etc.
Starting with Selenium testing would be a good choice, based on current IT industry trends. It will be simpler to learn the basics because it is a free testing tool that supports many programming languages such as PHP, Java, Ruby, Python, and others. Selenium is therefore in great demand in business, and many start-ups prefer it to QTP because of the latter's expensive licensing costs.

VI. CONCLUSION

In this paper we have evaluated two software testing automation tools, i.e. Selenium and QTP, on the basis of relevant parameters. The research concludes that on the basis of these parameters of automation tools for an application to be tested, trade-offs can be made to pick the optimal tool for a certain testing goal. Based on our research, QTP is a more capable tool than Selenium since it can test web, desktop, and server-side applications. However, Selenium is the most commonly used tool for automation testing because it is not only open source but also provides testers with multiple testing features. It has higher security and better execution speed. However, a big problem in QTP is about upgrading if it is not done with respect to the upgraded browsers, it becomes hard to perform testing. In fact, Selenium is recommended for someone just starting out in automation testing because it is free and supports a number of programming languages.

VII. FUTURE WORK

The major benefit of implementing automated tools is that you may save time and work by automating the testing of each element of your website. The study has shown that Selenium is the most highly used tool for web applications for web-based automation testing and automated solutions for this type of testing. Future work may consider if QTP does advancement in its upgrading feature then it can compete with Selenium in a more extensive level. However, if cost is not given priority and security is give priority along with flexibility, QTP can be used along with Selenium and future integrations can take place as Selenium is not flexible with testing of applications other than web based, as compared with QTP.

VIII. ACKNOWLEDGEMENTS

Credit Author Statement: Sana Fatima: Conceptualization; Methodology; S. Faiza Nasim: Data Curation; Writing-Original Draft; Zoha Akram: Editing; Visualization; Investigation; Mubeen Rasheed: Preparation; Writing- Reviewing; Najmi Ghani Haider: Review & Supervision.
REFERENCES


