A Review of Automated Testing Approach for Software Regression Testing

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Abstract. One of the important parts of software development life-cycle is software testing and one of which is regression testing. Regression testing is done to verify that previously detected errors have been corrected correctly and no new errors arise as a result of incorrect corrections so that the quality of the software being tested is maintained. It is important and must be done. However, the conventional method is not efficient as it is time-consuming, not reusable, and prone to error. In this paper, a comprehensive review of the automated testing approach is presented to be used by other researchers in this field of study. The review result shows that the automated testing approach is suitable to enhance the regression testing with some plausible options of tools e.g. Selenium, SAHI, and Robot-framework. Furthermore, some plausible options of execution methods are also discussed in this paper. This review further concludes that the parallel execution method is considered as a promising choice to conduct the most efficient regression testing process.

1. Introduction

One of the important stages of software development life-cycle is software testing. According to Galin [1], software testing is a formal process carried out by a special testing team that will examine a software unit, several integrated software units or an entire software package by running programs on a computer. All related tests are carried out in accordance with approved test procedures in approved test cases. One type of software testing that is important to conduct is regression testing. Regression testing is carried out to verify that previously detected errors have been corrected correctly and no new errors arise as a result of incorrect correction [2]. Regression testing is important and must be done.

However, the conventional method which is the manual regression test is not efficient as this method is very time consuming, the test is not reusable, and the process is prone to tester error. In this paper we explain and describe several previous studies about automated testing approaches on the regression testing. The review result shows that the regression test can be done based on automated testing approach by employing several tools namely Selenium, SAHI, and Robot framework. This paper also discusses some plausible option of methods to execute the automated test to be used by other researchers in this field of study which is consist of serial execution method and parallel execution method.
2. Regression Testing

2.1. Regression Testing
When a change is made to the software, several aspects of the configuration of the software (program, documentation, or data) will change [3]. Regression testing is carried out to verify that previously detected errors have been corrected correctly and no new errors arise as a result of incorrect corrections [2]. Regression testing helps to ensure that the changes made to the software do not lead to unwanted behavior or additional errors in the software[3]. According to [1], a regression test suite consists of 3 different test case class, which are:

a. A representative sample regarding the test that will run all software functions.
b. Additional test that focuses on software functions that will likely be affected by the changes that have been made.
c. Test that will focus on the changed software components.

2.2. Regression Testing with Conventional Method (Manual Testing)
The conventional method to conduct regression testing is manual testing using a human tester. It is considered not efficient as it is very time consuming, the test is not reusable, and the process is prone to tester error. Manual testing is a software testing without any automatic software testing tools or any script test. In manual testing, a tester positioned him/herself as a user and utilizes the tested software features to ensure that said software is bug-free [4]. In manual testing, test scenario or test case is written first and then followed by various steps in the testing execution[5]. To execute manual testing in the same section of software whenever a change is made is a relatively weary activity, and time-consuming. Another disadvantage of manual testing is a smaller extent of testing scope, a higher number of errors, and a higher number of testing staff requirements. Furthermore, several challenges in manual testing are tiring activities and dependent on tester skills such as patience level, speculative level, creativity, and competencies to consider every possibility of test data inputs[4].

3. Regression Testing with Automated Testing Approach

3.1. Automated Testing Approach
Regression testing can be done with the automated testing approach. Automated testing is a method in software testing that utilizes special software to execute a test and compares the expected execution result to the actual execution result. Automated testing could be done by utilizing software that specifically provides automated testing features. Automated testing enables an automated test execution, automated test execution scheduling, and automated test report generation [6]. According to [6] there are advantages that can be acquired by employing automated testing:

a. Able to run the existing automated test so that the effort to execute tests every time there are changes becomes easier
b. Able to run testing more often due to faster execution duration thus bigger assurance of the system can be acquired
c. Able to obtain the same level of consistency repeatedly, which is hard to obtain in manual testing.

Various research regarding automated testing has been done by several researchers. Those research has proved and concluded fundamental things, such as the advantages of automated testing execution. Previous research by Peethambaran [7] and Shivatri [8] proves that automated testing is faster than manual testing. Next, research conducted by Amannejad also stated that the utilization of testing tools is an advantage of automated testing. The coding of automated testing cases takes a lot of time if done one by one for every test case. Moreover, if the tester who is involved in automated testing does not
have sufficient knowledge regarding the programming language to make automated testing source code[9].

Another research conducted by Kaur and Gagan Gupta also elaborates that if testing is done manually, the shortage of testing time will be bigger due to one problem occurring if done with manual testing will take time and even if there is a lot of time spent on it, not all errors can be found[10]. Whereas follow-through research about automated testing by Naidu elaborates that compared to manual testing, automation testing can escalate testing coverage, accuracy, time savings, and also costs [11]. The same statement also mentioned by Singh and Bindia[12].

3.2. Automated Testing Tools

In the field of automated software testing research, many software to supports the testing process is available to be employed. Various software that has been researched are Selenium WebDriver, SAHI, and Robot framework.

3.2.1. Selenium. In his research de Castro et al. stated that Selenium is a tool that he considered to be the most popular tool to carry out an automated test on a web-based software [13]. Subsequently, Leotta stated that Selenium has 2 approaches in test script development, which are Capture and Replay and Programmable Test[14]. Both have their own unique advantages but Programmable test offers a cheaper cost in maintenance test case than Capture and Replay. Aside from the cost, Selenium also possesses more advantages such as co-evolve on the test script. In test script development with Capture and Replay approach there exists a tool known as Selenium IDE. Whereas in test script development with Programmable Test there exists a tool named Selenium WebDriver. Selenium WebDriver is a programming library that can be used to control a browser during an automated testing process. Selenium WebDriver supports the programming languages Java, C #, Ruby, Python, Perl, PHP, and Javascript[15].

Naidu stated that Selenium has advantages in test case creation perspective, execution time on a single thread, logging and reporting, integrated script editor, and easier installation compared to SAHI. Leotta attempts to compare between Capture & Replay test using Selenium IDE with Programmable Test using Selenium WebDriver, to observe which one is more effective. Leotta stated that the initial cost to create a test case using Capture & Replay is cheaper. However over time when the tested application is in reparation then the created test case must also be repaired, Programmable Test offers a cheaper cost, but this is also affected by the technical skills owned by the test case scripter [11].

3.2.2. SAHI. SAHI is a competitor to Selenium. In contrast to Selenium, SAHI has a feature to execute test cases in parallel, thus enabling a shorter time of execution if the feature is used. However, according to Naidu, SAHI’s performance is thwarted by selenium in the perspective of test case creation, execution time on a single thread, logging and reporting, and integrated script editor. Moreover, according to Naidu, the installation of SAHI is more difficult compared to Selenium. If Selenium is targeted towards programmers, then SAHI is targeted towards non-programmer testers [11].

3.2.3. Robot Framework. Research related to automated testing has been done by Peethambaran by using a tool called Robot framework. Peethambaran developed an automated test for the Metinfo application, an application in the field of Forest Data Collection and Analysis. The research used Robot framework which is equipped with Apium plugin. In Peethambaran's research, it is proven that the execution process carried out by automated testing can be done faster than manual testing[7].

4. Execution Method

4.1. Serial Execution Method
In executing an automated test, two methods could be used. One of the methods of execution in automated tests is serial execution. In serial execution, each scenario in an automated test will be executed alternately. An automated test scenario will be executed after the execution of the previous automated test scenario has been completed. This makes the automated test serial execution process inefficient in terms of time. However, in some automation tools, serial execution is the default execution method. Hence currently researchers are trying to develop the parallel execution capability on some of the automation tool which is explained in the next section.

4.2. Parallel Execution Method
Another execution method to execute an automated test is the parallel execution method. Research related to the execution of automated tests in parallel has been conducted by Naidu who tried to execute automated tests in parallel with Selenium without the use of certain testing frameworks. The results of the study show that the process of executing automated tests in parallel cannot be carried out if Selenium IDE is used, but if SAHI is used it can be done [11]. Another research related to the execution of automated tests in parallel has subsequently been conducted by Abdull Razak and Fahrurazi who tried to carry out automated test execution in parallel on the PyTestFramework framework. In that research Selenium is used as an automation tool and Python as a platform. In this research, automated test execution can be carried out in parallel but Selenium Hub or Selenium Server is needed as a link to forward the test script to the browser driver. In that study, it was known that the existence of the hub caused a delay in the automated test execution process [16].

Another research related to the execution of automated tests in parallel has subsequently been conducted by Fajar who developed a platform so that Selenium users can carry out automated test execution in parallel without the use of Selenium Server. In his research, Selenium Server was eliminated and was replaced by calling the Webdriver API directly by developing a platform independently. The platform will take time investment to build and maintain. Furthermore, given that the platform is a non-open source platform, there is no assurance of continued support from its developers, which is important in the continuity of the regression testing process with an automated testing approach [17].

Research by Sutapa et al. presented a parallelization approach for the execution of Serenity framework based automated test. In his study between the test script with the browser driver will be connected directly without the need to use a hub so that there is no delay in the execution of automated tests. In his study, a parallelization tool based on open source is used. The tool is the Maven Failsafe Plugin. In his study, the speed of execution of the automated test can increase by 118.14% so that the time required for the test execution is highly reduced [18].

5. Conclusions
Regression testing can be conducted either by manual testing or automated testing approach. Based on the literature review, the automated testing approach is providing a faster execution time and the minimum possibility of human error. The review result shows that the automated testing approach is suitable to enhance the software regression testing with some plausible options of tools such as Selenium, SAHI, and Robot framework. The use of automated testing approach could also make a lesser cost due to the advantages of reusing the test.

Furthermore, some plausible options of execution methods which consist of serial execution method and parallel execution method are also available. Based on the literature review, we conclude that the parallel execution method is considered as a promising choice to conduct the most efficient regression testing with an automated testing approach due to the reduced time required for the test execution than the serial one.
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