DevOps CI Automation

Continuous Integration

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Abstract- *In the IT sector, DevOps is the trend. This is the procedure for tying the Development and Operations teams together. It will aid in the automatic completion of the SDLC and STLC processes.*

This project aims to put the DevOps automation pipeline concept into practice. To achieve the purpose, a variety of methods and technologies are employed. The source codes are stored in GIT hub, and the Continuous Integration process is handled by Jenkins. Web applications are written in Java and stored in a GIT repository. Similarly, for the purpose of test automation a test framework is created and is stored in a separate GIT repository. Selenium is the powerful tool for Test Automation and TestNG add more flavors into it. Jenkins automatically creates a build whenever any new test are added/updated or commit is madein to GIT. The automation tests are then executed.

Keywords—DevOps; GitHub; Jenkins; styling; frame work; CI/CD; Maven;

I. INTRODUCTION

1.1 Overview

DevOps, is the new and updated method of software development life cycle. It will not the same as the traditional model like waterfall or V-V. By the help of DevOps, both development and operation are able to deliver defect free and smooth applications to the end users.

DevOps is a combination of Development and Operation tasks. To make it very clear it is the key concept of Continuous Integration and Continuous Deployment. Test Automation play a vital role in the CI/CD pipeline. Since everything is automated here, once any new change is implemented by any developer, the same will be tested automatically and deployed in higher environments if all required test cases are passed. Hence, this is the wonderful approach for software development and testing in the current IT market.

1.2 AIM OF THE PROJECT

To implement fully automated DevOps CI framework for Test Automation.

1.3 SCOPE

Identify a good Web Application

Development of an Automation Test Framework

Implementation of DevOps CI Pipeline

1.4 PROBLEM STATEMENT:

The typical software development and testing approach produces the following key issues when implementing and deploying new software:

- Usually, conflicts happen between the operation staffs and the development team due to the demand of stable build after deployment.

- Lack of Regression Testing leads to failure in Live environment.

- More manual testing efforts in frequently release cycle like Agile and DevOps

To eradicate the above issues, DevOps with CI automation pipeline is created and an automation test suite is created in order to identify the defects in each code change. Whenever there is any change to the application code or test framework, automatically the software is built, tested and deployedon the production system[6].

II. SIGNIFICANCE

The ideas of CI Automation in DevOps follow the agile practice. It helps to refine the complete STLC life cycle in an automated fashion.[5]. This is how a lot of bugs are identified prior to release of any application to production environment. Naturally, this CI and CD

methodology help to both development & test team, and operation team in a project.
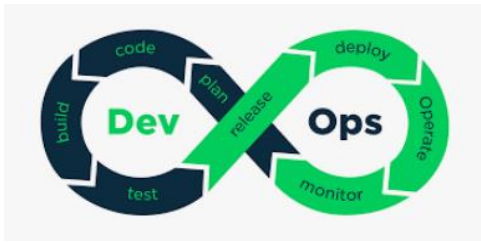
III. RESEARCH METHODOLOGY

DevOps is recent and updated methodology in current IT industry which aimed at bringing both software development teams and operation teams together to improve work throughout the software development lifecycle (SDLC) and Software Testing Life Cycle(STLC)[1].

CI/CD is the fashion for delivering application to end users more frequently by incorporating automation testing into the app development process[9].

Continuous Integration (CI) automation is the key factor of the Test Framework in DevOps environment.

IV. REQUIREMENTS

SOFTWARE REQUIREMENTS:

- Source Code Repository: GIT, GitHub

- Programming Language: Java

- Test Automation: Selenium, Junit, TestNG

- CI Tool: Jenkins

- Build Tool: Maven

V. SYSTEMANALYSIS

A) Development

We can develop an application using Java and SQL. Otherwise, we can take any reference Web Application for automation purpose. In this project, a web application is used- Orange HRM. This is basically used for Human Resource management activities.

B) Test Automation Framework

A test automation framework will be designed for the web application in order to validate the functionalities. Selenium and TestNG will be used for writing the test cases[6]. This framework contains basic packages for the suitability of the user.

Page Object Model (POM) is the idea used in this framework to store all the page objects in a designated package. This package stores all the page class written in Java. Encapsulation is used to bind both the variables and methods in these classes for better use. All the pages objects are class level variables and the methods are created to use those variables in other areas of the framework.

Test Cases are stored in another package. These are the TestNG tests written for the Orange HRM application. Basically @Test, @Before, and @After annotations are used in the test classes. All the tests are defined by the @Test annotation in the test framework. All main functionalities are covered as part of the test cases. TestNG assert statements are used to validate the expected and actual outputs of a test result.

Utility is another package where TestBase class is created. Basically, TestBase is a class where the WebDriver instance is created once and is used across the framework. Using Inheritance, all test case classes extend the Base class to reuse the WebDriver instance and other stuffs like browser instances, logs, screenshot, reports etc.

A Constant class is created in order to stored all the username, password and other URL. In this class, all the variables are declared as public, static and final, because the value of these variables should not be changed when other classes want to use this. This is also part of the utility package.

The framework contains a separate folder for drivers. Since selenium provides different drives for different browsers, this dedicated folder stores all the required drivers such as Chrome, Mozilla, IE etc.

Logs is another folder which contains all the logs during execution. Test Framework contains all the logging mechanism during the execution. Date and Time stamp is recorded for all the test executions.

Target folder is automatically created and the necessary reports are generated at the end of the execution. This report can be shared with other stakeholders of the project.

C) DevOps- CI Automation Pipeline

All the codes are stored in GitHub repositories. Jenkins is used to build the application. Maven is used to create the build. TestNG is used for running the tests and publish the HTML and Extended reports.

Continuous Integration is the technique where we need to add our test cases to the existing suite in an ongoing basic. In addition, we make sure that the exiting functionalities of the application is not affected by the

new change. This is why tests cases are executed on a daily basis. Jenkins used to schedule the corn job which helps the test automation framework to run based on the schedule.

Apart from the above process, Jenkins also provides another facility so that whenever there is any commit to the Git repo, automatically the build will be triggered which is called as Continuous Integration of test cases.

In this way we do achieve the regression testing of all existing functionalities of the application. This CI idea of DevOps methodology helps the project team members to minimize a lot of production issue in live environment

We have the facility ton execute the job in Jenkins on an ad-hoc basis just to ensure the local testing purpose is fulfilled.

At the end of each execution, all stakeholders will receive the email notification containing all detailed test results.

VI. SYSTEM DESIGN & ARCHITECTURE

### A. Proposed System Architecture
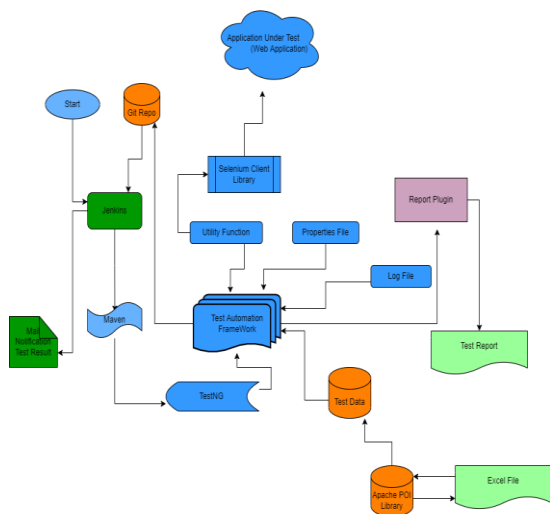
The heart of the system is the Test Automation framework. It's a java-based structure and selenium is used for UI automation. TestNG is the framework used for testing and reporting purpose.

Jenkins is the CI tool used in this project. All the test cases and the related utilities are stored in the GitHub repo. Once there is a commit triggered in the Git repo, automatically a build will be generated in Jenkins and all the regression test cases are executed. This is the whole idea of automation and Continuous Integration in DevOps environment.

Test Framework is created with a lot of functionalities. A specific area is allocated for test cases, POMs of all pages, utilities such as Drivers, Logs, Property file etc. All the JAVA OOPs concepts are applied in order to build the framework.

After the build is successfully triggered, it will show the detailed test result via email notification. Also, a user can view all the details inside Console Output for the particular job. This job also can be triggered on ad-hoc basic as per user's need.

B. System Work FlowChart
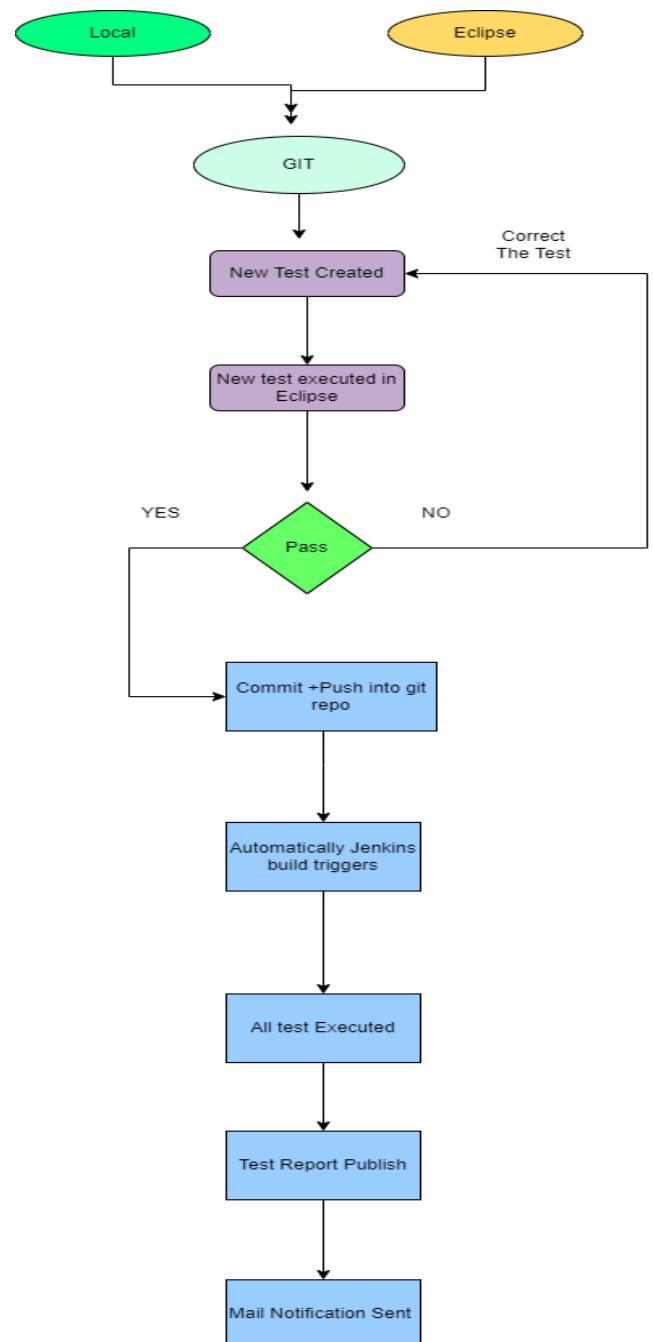
C. Aim and Objectives

a) Choose any Web Application

b) Develop Automation Test Framework

c) Implement of DevOps-CI Automation Pipeline

VII. LITRETURE SURVEY

F. Leymann, V. Andrikopoulos, and J. Wettinger,[1]. DevOps is the new way of software development life cycle. This helps both Dev and Test team to deliver a defect free product within time and zero defect. The concept of containerization also adds a lot of value to the new era of software development. Instead of waiting for the deployment team, now a days, everything is automated fully. Hence, testing is also implemented in an automated way so that if all testes pass, auto deployment will happen in higher environments.

S. Latkowski, D. Pustakhod, M. Chatzimichailidis, W. Yao and X. J. M. Leijtens,[2[Testing in DevOps plays a vital role. Specifically Test Automation is the key point in any DevOps model. Since DevOps is the conceptual framework for both Dev team and Ops team, Test automation comes inside the Dev team in order to provide a defect free delivery at the end. As a result, the end users will not face any issues or failures in production environment.

F. Zampetti, S. Geremia, G. Bavota and M.Di Penta, "CI/CD Pipelines Evolution and Restructuring: Continuous Integration and Continuous Delivery is the new method of software integration with the existing repo. Usually, developers push their changes into a repository such as Git hub, Bit bucket, SVN, VSS, AWS Code Commit etc. Since the work culture is now distributed in nature, each commit from different developers is stored in the repo in a distributed fashion. As a result, dependency is minimized in order to push the code into a release/master branch of the repo. Since Test Automation plays a vital role to identify the test failures in any new code, Continuous Integration (CI) provides the way to find out the regression issues from existing test cases as well which helps preventing defect leakage to production environment. Deployment in any higher instance is completely depends upon the test cases result. If all test pass, automatically the branch will be deployed in the higher environment. This is why we can call the full process as the CI/CD pipeline. In market, Jenkins, Bamboo, AWS Code Pipeline etc. tools are used in order to achieve the CI/CD. Normally CI/CD is the key concept in DevOps methodology [6].

VIII. CONCLUSION

DevOps is the new way of working in current era. CI/CD is the key concept of DevOps. When DevOps joins hand with test automation it will be a fully-fledged automated system.

DevOps is a fantastic tool for businesses. It establishes a smooth path for Continuous Development and Continuous Integration. It helps to bridge the gap between developers' demand for change and operations' resistance to change in every project.

All the IT giants like Netflix, Amazon, Etsy and Google used to use this approach successfully. It's not limited to any specific industry. Mostly all the industries like Healthcare, Finance, Mining, Banking, Insurance etc. are using CI/CD automation frequently to update the delivery and test automation process

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