

Research on Automation Testing Technology Based on Image Recognition

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Abstract—Aiming at the problems of how to efficiently validate the software with graphical interface and avoid tedious duplication of work to save time and reduce costs, a design method of the automation testing based on image recognition is proposed. The automation testing based on image recognition can verify the appearance of page elements and the relative positions between elements effectively and can directly support the software testing in various operating systems. In the long time continuous testing, the automation testing based on image recognition is more reliable comparing with the automation testing based on identifying the object of the software under test. What's more, it has no special requirement for testers' programming ability. The experimental results show that the proposed method of automation testing based on image recognition testing has its unique advantages in software testing, which can effectively verify the software with graphical interface, improve testers' work efficiency and save costs to accelerate the iteration of software development and version.

Keywords—Mobile; Web; Application; Automation; Test; Testing; Image Recognition; Image Comparison

I. INTRODUCTION

In recent years, with the rapid development of Internet technology, the application software based on Internet is more and more widely used in people's lives, and has become an important channel for enterprises and people to communicate. The expansion of enterprise business often depends on the development and implementation of business processes in web or mobile applications. Generally speaking, in the whole process of software development, the workload of testing accounts for 30%-40%, or even more than 50% [1]. How to effectively conduct software testing to shorten its development cycle, and how to quickly distribute software products to customers on the premise of guaranteeing the quality of software and user experience has become an important issue faced by enterprises. In the process of software testing, it is imperative to use automation testing technology to improve efficiency and save time. The automation testing technology based on image recognition is discussed below, and its effectiveness is demonstrated.

II. IMAGE RECOGNITION

A. Overview of image recognition

Image recognition refers to the technology of using computers to process, analyze and understand images in order to identify the targets and objects of different modes. The mathematical essence of image recognition problem

belongs to the mapping problem from pattern space to category space. At present, in the development of image recognition, there are three main recognition methods: statistical pattern recognition, structural pattern recognition and fuzzy pattern recognition. Image segmentation is a key technology in image processing. Since the 1970s, its research has been decades of history and has been highly valued. So far, thousands of segmentation algorithms have been proposed with the help of various theories, and the research in this area is still active. There are many methods of image segmentation, such as threshold segmentation, edge detection, region extraction, and the segmentation with specific theoretical tools. From the type of image perspective, it can be divided into gray image segmentation, color image segmentation and texture image segmentation.

B. The process of image recognition

The process of image recognition includes four main processes: data acquisition, image preprocessing, feature extraction and pattern recognition. The main task of data acquisition stage is to acquire the recognized image. Because the image contains a lot of background noise, such as light and resistance, electromagnetic and component interference and other internal conditions, it is necessary to process the input image to eliminate irrelevant information and extract useful information in the image preprocessing stage. In the feature extraction stage, the attributes, such as color, shape and space, are extracted from the image to facilitate the recognition of the target image, which lays the foundation for the next step of recognition. In the stage of pattern recognition, the feature information of the image is processed and analyzed to describe, recognize, classify and interpret the image. At this stage, we need to select the appropriate pattern recognition algorithm, compare the predicted image with the pre-saved reference image, and finally output the recognition results [2].

III. AUTOMATION TESTING TECHNOLOGY BASED ON IMAGE RECOGNITION

A. The automation testing based on image recognition

The testing technology based on image recognition is a automation testing technology that obtains and saves the baseline image of the correct application software page in advance, and then compares the tested page image with the baseline image and outputs the test results in the dynamic test execution process by using the advanced image recognition technology [3]. Mobile applications' automation testing tools based on image recognition, such as Mobot [4], simulate human hands with robotic arms, simulate human eyes with high-definition cameras, and operate the mobile

devices under test. Before the testing is executed, testers need to save a large number of baseline pictures and draw automation testing graphical workflow according to manual test cases. When the test is executed, the tool captures the actual screen image with a camera according to the steps in the workflow, and then compares it with the pre-stored baseline pictures to verify whether it matches or not. During the testing process, the tool uses image recognition technology to validate the page elements, and then the robotic arm clicks or slides on the target elements to promote the test.

Following is an example of Mobot, an automation testing tool based on image recognition, to illustrate the testing process.

1) Write test cases. Write test cases based on functional processes or user interface requirements to be validated. Testers need to use black box test case design method to design test cases.

2) Create test cases in Mobot. According to the designed manual test cases, the corresponding test cases are created in Mobot, and the component provided by the tool is used to design the execution flowchart for each test case. The following figure 1 is a test flowchart example.

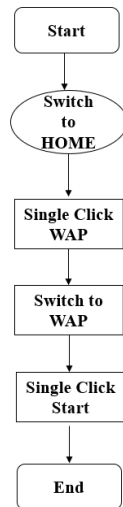


Figure 1. Test Flowchart

3) Set the baseline picture. Set the correct baseline image for each test case in Mobot.

4) Debug the execution of the test. Mobot executes the test according to the pre-set test flowchart. Click on the run button to debug the execution of the test.

5) Test execution. After the software code is completed, the software is installed on the mobile device, the mobile device is placed in Mobot, the test cases are run, and the mobile application is tested.

6) Analysis of test reports. For failed test cases, Mobot can report failure information in log file, and automatically save the execution video of failed test cases. Testers can

analyze the reasons of failure and submit defect reports according to the video.

Practice has proved that Mobot automation testing tool based on image recognition can not only effectively test user interface and functional business processes, but also perform 7*24 continuous stability testing, and capture performance defects in stability testing, such as the crash issue in some specific operation processes.

IV. COMPARISONS WITH OTHER AUTOMATION TESTING TECHNIQUE

A. Comparison of Realization Principles

In the field of automation testing for web applications or mobile applications, Selenium, Appium and SeeTest are popular automation testing tools [5]. These automation testing tools are based on the automation testing technology of identifying the object of the software under test. They are the automation testing technology that identifies and validates the tested object by querying the attributes of the tested page elements in the software under test. Testers use programming language to write automation test scripts, rely on the execution of the program to determine whether there are page elements which contain the target attributes (such as id, XPath, etc.) in the software under test to achieve the goal of automation testing [6]. When locating elements through id, the automation testing tool takes the value of the element id, such as finding the element with ID "reserve" in the Mobike App, and the Appium script command is `driver.find_element_by_id("com.mobike.mobikeapp:reserve")`; when locating elements through XPath, the automation testing tool queries the objects in the current page elements and sub-elements that satisfy the specified conditions, such as in the App Mobike, search the element whose resource-id is `com.mobile.mobikeapp:reserve` in any element and sub-element of the current page, and the command of Appium script is `driver.find_element_by_xpath("//*[@resource-id='com.mobile.mobikeapp:reserve'])`, where `//*[@resource-id='com.mobile.mobikeapp:reserve']` means to search in all elements and sub-elements of the current page. `[]` means that certain conditions should be satisfied. Then, for example, in any element and sub-element of the current page of App for Mobike, search the element whose text is "Reserve Car". The Appium script command is `driver.find_element_by_xpath("//*[@text='Reserve Car'])`.

B. Comparison of the effect in practical application

What kind of automation testing technology should be used in actual projects is a problem which is often encountered by enterprise R&D teams. The comparison of different automation technologies is as below.

In the verification of page text content, the automation testing technology based on identifying the object of the software under test is to obtain the accurate text content by the software under test and then compare it with the expected text content in the test script to output the verification results. The automation testing technology based

on image recognition is to identify the page content under test by image recognition to make sure the text content on the page under test is consistent with the text content of the baseline page. Because the image recognition algorithm has some deviation, the test results of the automation testing based on identifying the objects based on image recognition may be inaccurate. But the automation testing technology based on identifying the object of the software under test can easily and accurately obtain the text information of page elements. Therefore, for the validation effect of text content, the automation testing technology based on identify objects of the software under test is better than the automation testing technology based on image recognition.

In the validation of the page element images and the relative position of elements, the automation testing technology based on identifying the object of the software under test is to determine whether the page under test contains the target elements by detecting whether there are id, XPath and other attribute values of the elements in the software under test. Therefore, the automation testing technology based on identifying the object of the software under test can only validate the existence of page elements, but can not verify the correctness of the image appearance of page elements and the relative position between elements; the automation testing technology based on image recognition is to determine whether the elements of the page under test are consistent with the elements of the baseline page to verify the appearance of page elements and the relative position between elements. Therefore, the automation testing technology based on image recognition should be used to verify the appearance of page elements and the relative positions between elements, while the automation testing technology based on identifying the object of the software under test can not cover such verifications.

In the aspect of supporting the operating system of software under test, when using the automation testing technology of identifying the object of the software under test to do the verification, we should fully consider whether the automation testing tool can support the operating system of the software under test, whether it can cooperate well with the operating system, and how to configure it on different operating systems. The automation testing technology based on image recognition completely simulates human operation, does not need to consider the operating system of the software under test, and can directly support software testing in various operating systems.

In the long time continuous testing aspect, for the automation testing tools based on identifying the object of the software under test, the server side needs to communicate messages with the client side, uninterrupted testing may cause the temperature of the client, such as mobile devices, to be too high and eventually lead to the device' state disorder, thus affecting the accuracy and validity of the test results. The automation testing based on image recognition completely simulates human behavior, and does not interact with the clients for messages. Therefore, in the long time continuous testing, automation testing based on image recognition is more reliable.

In terms of skills needed for testers, automation testers who are engaged in the automation testing based on identifying objects based on the software under test are required to have strong programming ability, and should skillfully write and debug programs using programming languages to automate various test scenarios and solve various problems encountered in the testing automation. Automation testing based on image recognition has no special requirement for testers' programming ability, as long as the tester can draw workflow diagrams according to manual test case scenarios.

Of course, there are many similarities between the two testing technologies. Whatever automation testing technology is used, the automated tests can be repeated. Testers generally do not need to intervene the testing execution process, which can save time and improve work efficiency. After the test is executed, it is necessary to view and analyze the test report manually. Neither of the two automation testing technologies can meet the needs of automation testing for human intervention scenarios, such as the tests which are need to rotate mobile devices or the tests related to scanning human fingerprints. The automation of these tests can be achieved by using the technology of rotating mobile devices with robotic arms and simulating human fingerprints.

V. CONCLUSIONS

In summary, the automation testing technology based on image recognition has its unique advantages. In the testing of web applications and mobile applications, automation testing technology based on image recognition can be used for large-scale functional testing, user interface testing and performance testing to improve testing efficiency and reduce testing costs. It is believed that with the development of artificial intelligence technology, the accuracy of image recognition will be higher and higher, and the automation testing technology based on image recognition will play a greater role in software testing.

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