



Research on Automatic Test Technology of Embedded System Based on Cloud Platform

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Abstract. Automated testing is actually a kind of software testing. Previous testing work was completed by testing engineers manually executing test cases. Embedded systems have been widely used in real life, and the corresponding embedded software scale is also expanding day by day, but the requirements for its development cycle and product quality have not decreased at all. With the development of embedded system, we urgently need a testing system that can test and analyze the software of embedded system on-line in real time in the unit phase, integration phase, system phase and other phases of software development to ensure the quality and reliability of the software. This paper designs and implements an embedded system automation test platform based on infrastructure cloud. The platform is built on infrastructure cloud environment, which can make full use of hardware resources and reduce hardware costs.

Keywords: Cloud platform · Embedded system · Automated testing

1 Introduction

With the rapid development of science and technology, the functions of both software and hardware are increasingly complicated today. How to complete the testing of software and hardware in the fast update iteration has become the top priority for all companies. Since the development environment and operation environment of embedded systems are different, the automatic testing of embedded systems should be conducted separately in the development environment and operation environment, which will greatly increase the cost of system testing [1], so it is required that the scale and complexity of embedded software also continuously improve. The quality and development cycle of embedded software have a decisive impact on the final quality and time to market of products [2]. The introduction of automation technology shortens the software testing life cycle and improves the maintainability and regression of software testing. Automated testing has become an indispensable testing method. This paper mainly studies how to build an automated interface test platform in the test cloud and use the platform to test the project to protect the software quality and improve the development speed.

2 Automated Testing

Automated testing mainly simulates some manual testing behaviors through computers, and completes some tedious and boring tests or tests that cannot be completed manually according to instructions. Through uninterrupted testing, automated testing can improve the testing efficiency and increase the utilization rate of testing environment [3]. According to requirements, testers can increase, decrease or modify the arrangement and combination of automatic test cases by themselves to avoid redundant tests when increasing the coverage rate of automatic tests. By using the automated testing framework, time and resources can be effectively utilized to improve testing efficiency. The design requirements of the currently applied embedded automatic test system platform are all configured by testers according to various kinds of software and hardware and environment. The stable operation of the test system is ensured by inputting data into the test system, and the output results are studied and analyzed [4]. Moreover, the development environment and operation environment of embedded software are not consistent, so even if the test is sufficient in the host environment, it cannot be said that there is no problem in running the software in the target environment. In order to realize automatic batch execution of test scripts and facilitate management of test scripts, the test management tool reads a test configuration file edited by a tester before sending a test request. Automated test types include unit test, integration test and system test. At present, only these three types of tests can be automated.

3 Automated Test Cloud Platform

Automatic test cloud platform software system as shown in Fig. 1, the software system of the automated test cloud platform is mainly divided into four parts, namely the desktop PC part of the test engineer, the server part of the cloud platform, the database part and the VTP executor part. In the distributed resource scheduling cluster, the virtual machines on the host with heavy load will be automatically migrated to the host with light load to achieve load balancing in the cluster.

In order to better manage the test and reduce the maintenance of test scripts, so that testers can write test cases, we have developed a set of automated testing framework to meet the current needs. The test case is downloaded to the target machine for operation through the communication interface (serial port or network). The information generated after the program is run is uploaded to the host machine through the communication interface, and then the received information is analyzed and processed. The configuration file will define the storage location of the test script set, the time interval for script execution, the communication time interval between the host computer and the target computer, and the number of stub points for each communication. Every time the software changes, we must retest the existing functions in order to determine whether the modification achieves the expected purpose and check whether the modification damages the original normal functions [5]. C language has played an important role in the automatic testing of embedded systems, greatly enhancing the practicability of assembly language and effectively solving the obstacles of technical communication.

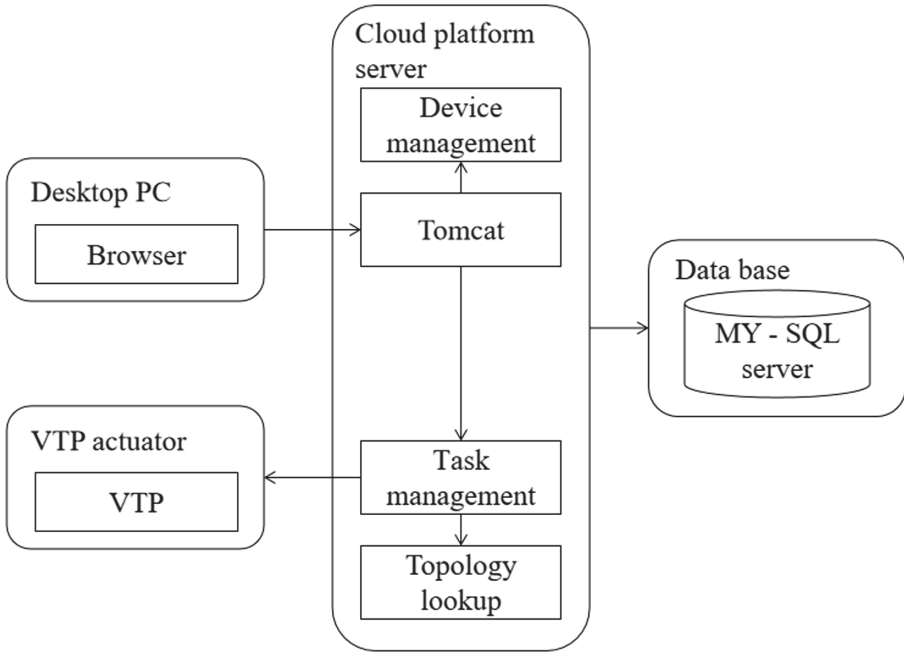


Fig. 1. Automatic test cloud platform software system

3.1 Typical Application Scenarios of Automated Test Cloud Platform

Currently, this infrastructure cloud environment is managed by a dedicated person, including various operating system template management, virtual machine mirroring and restore operations, virtual machine creation and deletion, etc. [6, 7]. The emergence of automated testing tools has reformed the traditional manual mode, making testing work enter the era of rapid development of automation. In the automated test cloud system, the test engineer can save the network diagram and configuration information when performing the test task for the first time in a test scenario, and only need to load the scenario saved during the first test again when the problem list regression is needed. Its main feature is that it does not run the program under test. It mainly uses inspection, technical review and code static analysis to check the errors of the software under test. For embedded software, the test only needs to be performed on the host computer. And transmits the script set at the specified position to the target machine side, and at the same time initializes each test variable according to the parameters in the configuration file [8–13]. Support the parallel execution of test cases on multiple clients, and increase the batch execution speed of test cases by adding hardware. Software users do not need to purchase additional hardware equipment, software licenses and install and maintain software systems. They can easily use the software at any time and at any place through an Internet browser and pay fees regularly according to usage.

4 Design of Embedded Software Automation Test Platform Based on Cloud Platform

The automatic test method of this project is designed as Host/Target mode in test mode, and the overall architecture adopts Client/Server structure. Host/Target mode means that the compile link and test analysis are both run on the host machine, while the tested program is run on the target machine [14–18]. The tester makes a test request to the target machine side through the test management tool, and transmits the script target file that has been compiled successfully to the target machine side. It must rely on the specification of requirements that can reflect this relationship and the function of the program to consider the test cases and infer the correctness of the test results, that is, it can only be based on the external characteristics of the program. After each test, it will automatically judge whether the work is completed or not, and after all tests are completed, it will automatically send all test data to the host computer. If the authentication can be passed, the authentication server will send relevant information to the user at the equipment end, and the equipment end will construct a dynamic access control list according to the information to control the access of the client. The communication between the target computer and the host computer is via serial port or network. The schematic diagram is shown in Fig. 2.

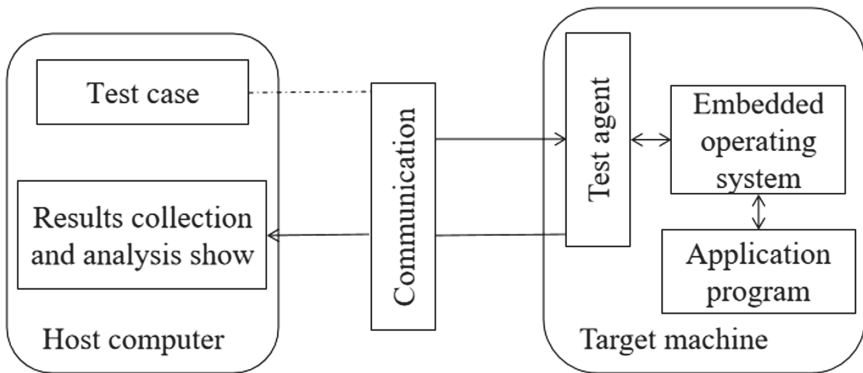


Fig. 2. Host/Target schema structure diagram

By executing all function test scripts, the platform pre inserts system code to capture the coverage of system code. The tester covered the report through analysis. According to the load, timing and performance requirements in the requirements, judge whether the software meets these requirements. It is necessary to analyze and study mainly subjective factors, and the inevitable objective factors can be ignored. The automated test cloud platform schedules and allocates resources through topology look up, which is the core algorithm of the automated test cloud platform. The control of the testing process needs to realize the automatic execution of the whole process from obtaining the testing code and the tested software to deploying the software and testing until the final release of the testing report without manual intervention. The basic framework layer mainly includes automatic test case engine, report engine and work-flow. Statistics

and display of the coverage of the tested software system and graphical display of the static calling relationship of the tested software system functions; The test agent controls the execution of the script, caches the collected test results and coverage information to a specific memory area, and the target machine sends the test results and coverage information to the host machine at fixed time intervals. That is, when the statement coverage rate is 100% and the branch coverage rate is $\geq 85\%$, the test is considered ideal, software errors can be detected by nearly 90%, and the consumption of time and space is allowed.

All data in the automated test cloud platform, such as automated scripts, device connection information and execution result logs, are stored in MY-SQL database. MY-SQL is an open source database, because of its open source nature, users can freely customize MY-SQL database according to their own needs. It is mainly used to control the execution of tests, so there is no need to cross the operating system platform and use Windows operating system. The control command is also a batch script command. Its slave machine can be used as a test execution machine, mainly playing the role of executing test scripts. Each tenant customizes its own service according to its authority. The second is the setting, management and control of permissions. The degree of customization of tenants' services depends on the granularity of resource permissions. When the tested source code changes, the source code can be recompiled to determine the modified part of the software and maintain the test case library; The test agent will judge whether the current script has been completely tested after testing each script, and if so, it will send all the remaining test data in the buffer to the host. Software quality is a mixture of many factors, or a combination of many factors. These factors may vary according to different application aspects and different user viewpoints. Therefore, the effectiveness of test cases becomes crucial and important, and more errors should be found and corrected in limited tests.

5 Conclusion

This paper innovatively proposes an automated testing framework and constructs an automated testing platform based on visual script. It is deployed as a service mode of cloud platform, and the automatic test of embedded system is deeply studied. Then, combined with the actual working situation, the test method of this embedded system is proposed, which realizes the functions of automatic compilation, automatic execution of test cases, etc. The automatic testing platform based on it can be realized, and daily integrated testing can be realized, thus protecting the development quality and reducing the development cost. However, the current platform still has some defects and has great room for development. Relevant technicians should continuously explore and make efforts to further promote the improvement of the automation level of the testing system.

References

1. Zhou, Y.: Discussion on automated testing methods of embedded systems. Eng. Technol. (Full Text Edition) 7, 00573 (2016)

2. Wang, S., Wang, Y.: Research on the automated testing framework for embedded devices. *Mod. Comput. Mid-term J.* **1**, 31–34 (2015)
3. Guo, Y., Chen, X., Zheng, C.: Research and implementation of software automation test method based on embedded security platform. *Railway Commun. Signal* **054**(001), 66–68 (2018)
4. Zhang, F.: Research on automatic evaluation technology of power application system based on cloud architecture. *Electr. Eng. Technol.* **6**, 00005 (2016)
5. Wang, W., Yue, L., Yang, J.: Design and implementation of an automatic test system for transmission line tower tilt based on embedded Linux. *Comput. Measur. Control* **024**(009), 70–73 (2016)
6. Cao, W., Zhang, K.: Research on anti-reptile technology based on automated testing-T mall platform as an example. *Mod. Comput. Mid-year Mag.* **4**, 64–67 (2018)
7. Chen, H., Fan, D., Huang, J., Huang, W., Zhang, G., Huang, L.: Finite element analysis model on ultrasonic phased array technique for material defect time of flight diffraction detection. *Sci. Adv. Mat.* **12**(5), 665–675 (2020)
8. Wang, S., Huang, Y., Liu, A.: Electric hoist energy efficiency automation tester based on internet of things. *Hoisting Transp. Mach.* **000**(001), 127–129 (2019)
9. Hamzah, R., Kasim, S., Hassan, R.: Taxi reservation system of BATU PAHAT taxi association. *Acta Electron. Malays. (AEM)* **2**(2), 20–24 (2018)
10. Li, B., Li, Z.: The implement of wireless responder system based on radio frequency technology. *Acta Electron. Malays. (AEM)* **2**(1), 15–17 (2018)
11. Li, B., Li, Z.: Design of automatic monitoring system for transfusion. *Acta Electron. Malays. (AEM)* **2**(1), 07–10 (2018)
12. Li, B., Li, Z.: The design of wireless responder system based on radio frequency technology. *Acta Electron. Malays. (AEM)* **2**(1), 11–14 (2018)
13. Basir, N., Kasim, S., Hassan, R.: Sweet8bakery booking system. *Acta Electron. Malays. (AEM)* **2**(2), 14–19 (2018)
14. Feng, Z., Shu, L.: Design and research of aerial three-axis gimbal control system based on ARM. *J. Shenyang Univ. Aeronaut. Astronaut.* **034**(003), 70–75 (2017)
15. Zamanian, P., Kasiri, M.: Investigation of stage photography in JEE LEE's works and comparing them with the works of Sandy Skoglund. *Acta Electron. Malays. (AEM)* **2**(1), 01–06 (2018)
16. Yan, Z.: Artificial bee colony constrained optimization algorithm with hybrid discrete variables and its application. *Acta Electron. Malays. (AEM)* **2**(1), 18–20 (2018)
17. Singh, O., Kumar, G., Kumar, M.: Role of TAGUCHI and grey relational method in optimization of machining parameters of different materials: a review. *Acta Electron. Malays. (AEM)* **3**(1), 19–22 (2018)
18. He, Z., Gu, X., Sun, X.: An efficient pseudo-potential multiphase lattice Boltzmann simulation model for three dimensional multiphase flows. *Acta Mechan. Malays. (AMM)* **1**(1), 1–3 (2018)