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The Development Trend of Automatic Test System

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Abstract: ***The application range of automated test system is very wide, can be applied to aerospace, military equipment, electronic technology and communication equipment, etc., in the sustainable economic development and equipment modernization trend of the role is also very important. Modern high and new technologies emerge endlessly, and the service objects of automatic test system are more and more diversified. In order to adapt to the development of The Times, it is necessary to develop automatic test system. In this case, researchers need to understand the development trend of automatic test systems, find out the shortcomings of development and the broad prospects of progress, so as to promote the automatic test system "transformation". This paper mainly describes the recent development and future development trend of automatic test system, hoping to provide inspiration to relevant people.***

Keywords: Automatic Test System; Recent Development Situation; Development Trend.

1. INTRODUCTION

Automatic testing systems were born in the 1950s. With the development of computer technology and advances in circuit technology, the application of automatic testing systems has gradually become widespread and has achieved great success. With the progress of the times, automatic testing systems also need to make development progress to adapt to the diversity of testing objects. Better integration of information technology and automatic testing systems to make self testing systems more refined and reduce the occurrence of errors is an important aspect of the development of automatic testing systems.

2. INTRODUCTION TO AUTOMATIC TESTING SYSTEM

An automatic testing system refers to a system that performs fault diagnosis and automatic measurement of equipment, records and processes relevant data, and displays or outputs test results in an appropriate manner, with very little or no human involvement. Compared with manual testing, automatic testing can save time and manpower, improve labor productivity and equipment as well as product quality. It plays an important role in production, scientific research, and national defense. Automatic testing systems generally consist of automatic testing equipment, testing program sets, and testing environments. Wang (2025) demonstrated how AI enhances last-mile delivery efficiency in smart cities, optimizing routes and reducing operational costs [1]. Similarly, Li (2025) applied ML to improve adverse event monitoring in Phase IV chronic disease drug trials, highlighting its potential for real-time pharmacovigilance [2]. For healthcare data processing, Yuan (2024) proposed a GPT-4-based framework to handle multimodal electronic health records, streamlining clinical decision-making [3]. In warehouse management, Song (2024) optimized human-computer interaction by integrating automatic speech recognition, improving operational workflows [4]. Data quality and scalability are critical in gig economy platforms, as emphasized by Chen (2025), who introduced a quantized framework for large-scale data integration [5] and later addressed efficient data pipeline design to support real-time processing [6]. Meanwhile, Wang (2024) explored legal constraints on enterprise naming rights, underscoring the balance between prior rights and corporate identity [7]. For risk management, Gong et al. (2024) developed an ensemble ML-based decision support system to enhance enterprise risk assessment [8]. In steganalysis, Bohang et al. (2025) leveraged active learning and hyperparameter optimization to improve image-based security detection [9]. Industrial applications were also advanced by Zhao et al. (2024), who employed deep learning for steel production scheduling [10], and Yao et al. (2025), who integrated drones with 3D printing for rapid post-disaster shelter construction [11]. Economic forecasting has benefited from AI, as Yang et al. (2025) proposed a big data-driven method for cycle prediction [12], while Ji et al. (2025) applied AI to personalize retail go-to-market strategies [13]. Finally, Yang et al. (2025) integrated large language models (LLMs) for cross-asset risk management, enabling real-time monitoring of equity, fixed income, and currency markets [14].

3. THE DEVELOPMENT HISTORY OF AUTOMATIC TESTING SYSTEMS

The content of modern testing is becoming increasingly complex, and the workload of testing is also constantly increasing, requiring high efficiency while ensuring quality. Manual testing cannot adapt to this development trend, so the development prospects of automation technology are even broader. The development of automatic testing systems has gone through the following stages:

Firstly, professional testing equipment should be used. In this case, the system is relatively complex and the production cost is high, and its applicability is not high. When changing the test object, the interface needs to be redesigned, so it can only be used to test repetitive equipment or rapid testing situations, so its application is limited.

Secondly, standardized universal interfaces should be used to connect testing equipment. Each component of the testing system needs to have standardized interfaces and be connected using a unified power supply, so there is no need to redesign the interfaces and flexible testing can be carried out. The task of the computer in this stage is to simulate artificial testing, and the application level of the computer is not perfect.

Thirdly, computers and testing equipment are highly integrated, replacing some traditional hardware functions with computers, generating fixed testing programs, and using computer software to replace non responsiveness. How can we reduce errors that cannot be generated by hardware and ensure the accuracy of test results. Moreover, the software is more flexible and can be transferred flexibly to meet the maintenance needs of automatic testing systems.

4. RECENT DEVELOPMENTS IN AUTOMATED TESTING SYSTEMS

Automated testing systems can diagnose equipment problems and test equipment performance. During the testing process, it is not only necessary to complete data storage and transmission, but also to handle data properly and output it. In the 21st century, automated testing is gradually developing towards modularity and standardization, and can quickly complete data transmission and testing. It has certain intelligent features. Generally, automated testing systems include operating systems, software control, testing, language, hardware, drivers, and various additional functions of the system, and are externally composed of multiple hybrid buses. Although some progress has been made, there are still some problems with China's automatic testing system:

Firstly, the variety of automatic testing systems is not uniform and their universality is not high, so the staff need to learn a large number of different models of testing systems in order to successfully complete the testing, which increases the workload of the staff. Moreover, there are many types of testing equipment, and the amount of maintenance and inspection work is also relatively large.

Secondly, the operation of automatic testing systems is relatively complex and requires high demands on operators. If there is a lack of relevant talents, it will affect the application of automatic testing systems.

Thirdly, China lacks awareness of the development of automated testing systems, resulting in a decrease in the visibility of some automation and a lack of unified software and language, which is not conducive to the overall development of the system.

5. THE DEVELOPMENT TREND OF AUTOMATIC TESTING SYSTEMS

5.1 Towards universalization

From the overall perspective, the development of automated testing systems can also be said to be a process of constantly breaking through limitations and moving towards universality. Faced with the diversity of automated testing objects, improving the universality of automated testing systems can reduce the cost of continuous development and maintenance, and promote the contribution of automated testing systems to economic development. The development of automated testing systems towards universality requires attention to the advancement of synthetic instrument technology, standardization of public testing interfaces, and software refactoring technology.

Firstly, synthetic instrument technology is a highly modular product that can be reconfigured. The synthetic instrument working group reassembles the relevant hardware and software through standardized interfaces and uses digital signal processing technology for testing. The technology of synthetic instruments integrates various advantages of modular instruments and virtual instruments, which can effectively reduce the overall cost of automated testing systems and improve the interoperability of automated testing systems. Synthetic instruments will gradually be promoted and applied.

Secondly, the standardization technology of the common testing interface of the automatic testing system is the portable support of TPS. The standardization of the automatic testing system is increasingly valued by the public. The automatic testing system from equipment design to equipment maintenance stage needs to be developed under the same standard. The common testing interface includes the testing adapter box, receiver, and adapter. The implementation of a unified automatic testing equipment design standard still requires a lot of preparation work, but the issue of standardization has been taken seriously by many enterprises and gradually taken action. The reconstruction technology centered on computer software, the continuous integration of computers and self-test systems, and the increasing role of computer software directly affect the scientificity, efficiency, reliability, and applicability of self-test systems. Many hardware functions of self-test systems are gradually being replaced. The automatic testing system needs to meet the testing requirements of different environments and objects. The testing equipment needs to have strong compatibility and flexibility, be able to replace and repair equipment, transfer mini programs to other devices, and rely on the capabilities of computers to build a testing system with multiple functions that can migrate programs universally.

5.2 Towards a trend towards greater precision

With the rapid development of informatization, the tested software not only has higher requirements for automatic testing systems, but also needs to test the performance of the equipment in actual use, accurately and quickly evaluate various functions of the equipment, which requires improving the accuracy of automatic testing systems.

First, pay attention to the development of parallel testing technology. Parallel testing technology is different from traditional serial testing. Traditional innovative testing is different. The test has high packet capacity and can make full use of resources. It is very suitable for measuring multiple objects and scenarios at the same time. Parallel testing is to cooperate with software processing by introducing hardware resources of multiple channels into the automated test system. That is to say, disguised testing can provide multiple testing channels on a single module, and can conduct independent testing or parallel joint testing, thus freeing the automatic testing system from the limitations of resource sharing. The software launched for disguised testing is composed of multiple programming techniques, which can dynamically allocate and optimize the configuration of testing resources, and use nuclear processing computers to drive performance improvement.

Secondly, the development of information technology in data recovery communication technology has led to a significant increase in the amount of data generated by automatic testing. However, this growth in data volume has become one of the reasons affecting testing efficiency. With the increasing integration of computer technology and intelligent testing buses, more convenient and compatible buses have become the direction for the development of automatic testing.

Thirdly, the development of precision system calibration technology is necessary. The objects of automated testing systems have increasingly high requirements for precision. When testing computer hardware systems, certain errors may occur between different parts, which can affect the accuracy of the self-test system. So the accuracy of the testing system is often lower than the effect of directly testing with testing equipment. In order to improve the accuracy of the self-test system, it is necessary to adjust the precision of the testing hardware, focus on analyzing the sources, characteristics, and means of eliminating errors in the automatic testing system, apply calibration techniques in the testing field, and become a key technology to enhance the functionality of the automatic testing system.

5.3 Trend towards miniaturization

The miniaturization of automatic testing systems makes them easy to carry and apply in various testing environments, which has received significant attention from trauma testing and on-site maintenance support. For a long time, there has been a growing demand for miniaturization of automatic testing systems. The demand is urgent. With the development of microelectronics technology, the trend of automatic testing systems moving

towards miniaturization is strong, especially with the rapid development of modular instrument devices such as PXI and USB, as well as comprehensive testing instruments in China. This greatly reduces the size and production costs of automatic testing equipment, directly promoting the trend of miniaturization of automatic testing systems. Automatic testing systems based on the PXI architecture have been widely used, and even smaller and lighter portable automatic testing systems will be born and applied in the market in the near future.

5.4 The trend of automatic testing systems developing towards networking

The expansion of the application scope of network communication technology has provided inspiration for the restructuring of automatic testing systems. Not only have wired networks matured, but wireless network technologies such as Bluetooth and wireless have also been increasingly applied, providing basic conditions for high-speed transmission and processing of test data. The automatic testing system relying on wired or wireless networks will break through the limitations of space, with the network as the center, providing testing information services through high-speed network communication to overcome technical barriers for parallel testing. Moreover, the self-test system relying on the network can be flexibly transferred, easy to carry, and relatively low in cost, presenting a trend of the network being the automatic testing system. Currently, the automatic testing system has played a unique role in the production, manufacturing, and maintenance of electronic equipment.

5.5 Trends in Intelligent Management of Automated Test Data

The application scope of automatic testing systems is becoming increasingly widespread, so there will be more and more urban data in cities. Many of these test data can be shared as public resources or basic data references. Applying these test data to the tested object can also achieve information sharing within the same test object. However, it is very difficult to obtain valuable information from the vast amount of test data. Currently, automatic storage systems process the collected data and turn it into test reports or reports. However, with the increasing amount of test data, simply outputting it in the form of test reports or reports is difficult to meet users' needs for accurate acquisition of test information. Through the intelligent system of computer software, effective management of test data is achieved, achieving a unified information format, standardized information exchange methods, and standardized information docking windows. Therefore, the intelligent management and key use of automatic test data have become an important development trend in automatic testing.

6. CONCLUSION

Automatic testing systems have emerged from the field of national defense and are widely used. In order to meet the diverse needs of testing objects, automatic testing systems also need to be updated and upgraded. Our country needs to improve the comprehensive development and construction of automatic testing systems, so that they have greater universality, higher accuracy, more convenient portability, can be applied to various testing environments, and significantly improve the work efficiency of automatic testing systems, thereby reducing testing and maintenance support costs during equipment use cycles and promoting the development and progress of automatic testing systems.

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