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A New Method for Testing the Perfection of Construction Machinery Parts Based on Artificial Intelligence

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Abstract: With the continuous development of artificial intelligence, more and more researchers begin to attach importance to the realization of perfection testing in products, especially the intelligent and simulation technology. In this paper, based on the combination of computer and robot, the simulation experiment on mechanical structure is carried out. This paper first introduces the important role of machine vision system in the process of defect detection of automobile parts, then expounds the method of feature recognition of automobile parts, related principles and key technical basic knowledge points, etc. Finally, a three-dimensional entity model simulating real products is constructed using MATLAB software, and its results are calculated and analyzed. The concepts of intelligence and simulation are described in detail. The test results show that, the accuracy of the model in detecting the degree of perfection of product parts is more than 90%, and the error rate is low. This shows that the testing performance of the model is excellent.

1. Introduction

With the development of computer technology, intelligence has become an indispensable and important part of the future social development. In the field of construction machinery, product quality is one of the most important and critical topics [1-2]. For a new thing, there will be many uncertain factors. Therefore, how to enable enterprises to better produce products with high qualification rate, low cost and meet user needs needs in-depth research and discussion of solutions to improve product performance and quality, so as to make the intelligent system more perfect, and reduce the loss of product use time and labor to a certain extent [3-4].

Many scholars have conducted relevant research on artificial intelligence. The research of foreign scholars on intelligent manufacturing mainly focuses on technology, product structure and design. At present, domestic experts have put forward many improvement methods for the problems faced by the mechanical industry [5-6]. For example, establish the object oriented program (PIC) model, develop the algorithm based on machine learning theory (BLOM) to solve the multi-objective programming problem under multiple constraints in complex systems, and optimize the product structure, modularize and simplify functions, integrate modules and perform parallel analysis. In this field, Chinese scholars mainly improve China's intelligent manufacturing industry by learning from foreign advanced research achievements. Some scholars believe that the system engineering method based on artificial intelligence is completely different from traditional industrial products. It emphasizes the new concepts such as "machine" and "mental labor tools work together", human-computer interaction design, etc. At the same time, it also puts forward the concept of mechanical functionalization and intelligent processing based on robot technology, and further studies and analyzes it, providing a theoretical basis for the realization of this field [7-8]. Therefore, based on artificial intelligence, this paper studies and designs the testing method for the degree of perfection of construction machinery parts.

This paper introduces the concepts of intelligence, artificial intelligence and machine vision, analyzes and studies the integrated testing method based on the combination of robot structure feature detection technology and sensors. Combined with the robot system design, a comprehensive evaluator based on the evaluation system of the perfection degree of construction machinery parts is proposed. First, it is verified by experiments that the system can realize the coordination test between different components. Secondly, it uses software development tools to conduct multi-objective collaborative evaluation. Finally, it uses language programming to complete the simulation experiment of the application process of intelligent machine vision in actual production.

2. Discussion on the Part Perfection Test of Construction Machinery Products Based on Artificial Intelligence

2.1. Product Perfection Test

The product perfection test refers to the comprehensive inspection and evaluation of different types of parts through the design method under a specific situation, the actual measurement of the tested object, and the determination of the location, size and distribution of the defects according to the measured data. Whether the product is perfect or not can be considered from two aspects. On the one hand, whether it meets people's needs for functions, performance and other aspects. On the other hand, it also depends on whether the process can reach the quality level required by users or beyond the expected value [9-10]. Secondly, it depends on whether the product itself can meet the needs of consumers and what problems may exist in the use process. Whether a product is perfect or not is to evaluate the quality of a product. It not only reflects the defects existing in the design and manufacturing process, but also reflects whether the materials or parts used in production practice have good performance, and test whether each part can play a role. In addition, the product design itself has some defects, such as its internal structure is not reasonable and compact enough. Physical model is to abstract a complex object with multiple functions and characteristics. It includes solid modeling design and physical structure design. For example, frames are common in construction machinery, and virtual machine systems such as robot programs and intelligent testers are used in smart phones. After that, it is also necessary to investigate and test the user's needs, including the work done by users in terms of problems, solutions and possible results when using the software.

The re data acquisition and processing system includes the overall structure of the product, the mutual cooperation between the functional modules of each part, and whether the connection between each component and the assembly method are reasonable [11-12]. Figure 1 shows the inspection process of product parts' perfection.

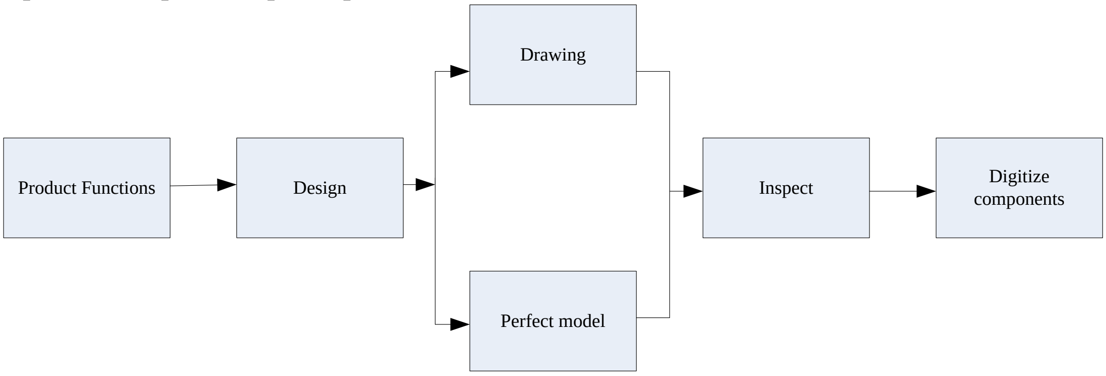

Figure 1. Product perfection degree test

2.2. Factors Affecting the Perfection Test of Product Parts

In a complex system, there are many factors affecting it, such as structure, function, materials and technology. The most important is the part itself [13-14]. Therefore, the entire system should be fully analyzed before testing. In this way, we can ensure that the final result is perfect or there are problems, and then we can find out the defects. For different types and quality specifications, product parts must have strict standards to ensure their qualified performance indicators. At the same time, we need to consider whether the tester has professional knowledge and relevant experience. After a lot of experiments and tests, it is found that there are many complex structures in the product, such as engine, gearbox and other parts. Although these structures have a high degree of characteristics, because there is no unified standard between different levels to evaluate, describe and analyze them, it is also necessary to consider some variables, such as error factors caused by mutual influence or interaction between various parts, to affect the perfection of parts. There are many uncertain or unpredictable problems in products. If a part does not complete the task well, it cannot realize its function. For example, a complete mechanical component can meet user needs to varying degrees. However, if these technologies cannot be fully used to improve efficiency and reduce costs, it will lose market competitiveness. On the contrary, when the parts are not perfect or defective, it cannot achieve the desired goal, It may even be that the invalid products cannot be used or the resources are wasted to cause losses. Because different parts have different internal structures and functions, the testing workload for the same part will be large. For example, in the assembly process, errors are generated due to differences between different parts to a certain extent. In addition, in many cases, the test results may not be ideal or cannot accurately reflect the actual state due to the influence of the material itself [15-16]. It also includes some other reasons, such as process, design and other reasons that cause product manufacturing defects or low production efficiency, which can be verified and corrected through experiments.

2.3. Artificial Intelligence

The concept of intelligent machine was put forward by Americans in the 1960s. With the research and application of computer technology, Internet, big data, artificial intelligence and other related fields, as well as the deepening of people's understanding of "computer aided engineering", human beings will further develop. At present, more than 90% of the world's robots or AI products are tested, verified or feedback evaluated after production to see whether the new methods have reached the expected goals, and whether they can be effectively diagnosed, improved and optimized when faults occur in the use process. The main function of the product is to complete the basic actions required by a robot, such as control, drive, etc. In this paper, the robot system realizes the intelligent processing of mechanical parts through artificial intelligence. For example, the information collected by the sensor and the internal settings of the processor are output to the neural network. The final results and parameter values are determined by the controller control algorithm, and the motion state (including the speed) is adjusted according to the specific situation to adapt to the work needs in different environments. Finally, complete an action cycle, that is, complete the task [17-18]. Figure 2 is the framework diagram of intelligent algorithm.

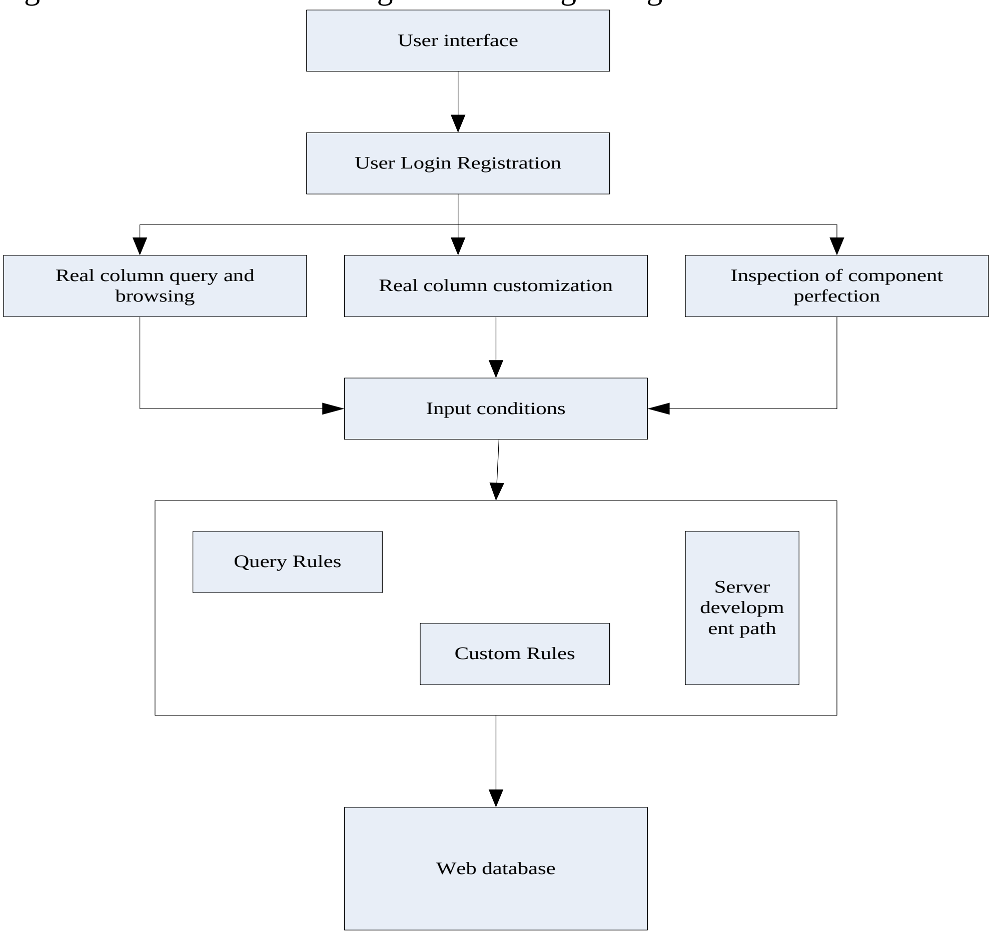

Figure 2. Intelligent algorithm process

In intelligent manufacturing system, the testing of parts' perfection is an important content. The quality inspection of parts and materials includes whether there are defects or cracks, strength and hardness, whether there is corrosion, etc., the geometric shape and dimensional accuracy of product structures, as well as the connection mode and assembly relationship between various parts, etc., which shall be fully inspected and recorded to ensure the qualification rate. The expression of this function is:

$$G(z) = \frac{1}{1+e^{-z}} \tag{1}$$

Thus, a prediction function h (x) is constructed, which represents the probability of taking 1 as the result.

$$h_\theta(x) = g(\theta^T x) = \frac{1}{1+e^{-\theta^T x}} \tag{2}$$

It can deal with nonlinear problems through the relationship between input data sets, hidden parameters and output results, and has good stability and robustness. At the same time, it also has the characteristics of reducing computational complexity and improving computational speed to a certain extent.

3. The Experimental Process of Part Perfection Test of Construction Machinery Products Based on Artificial Intelligence

3.1. Artificial Intelligence Based Testing Model for Parts Perfection of Construction Machinery Products

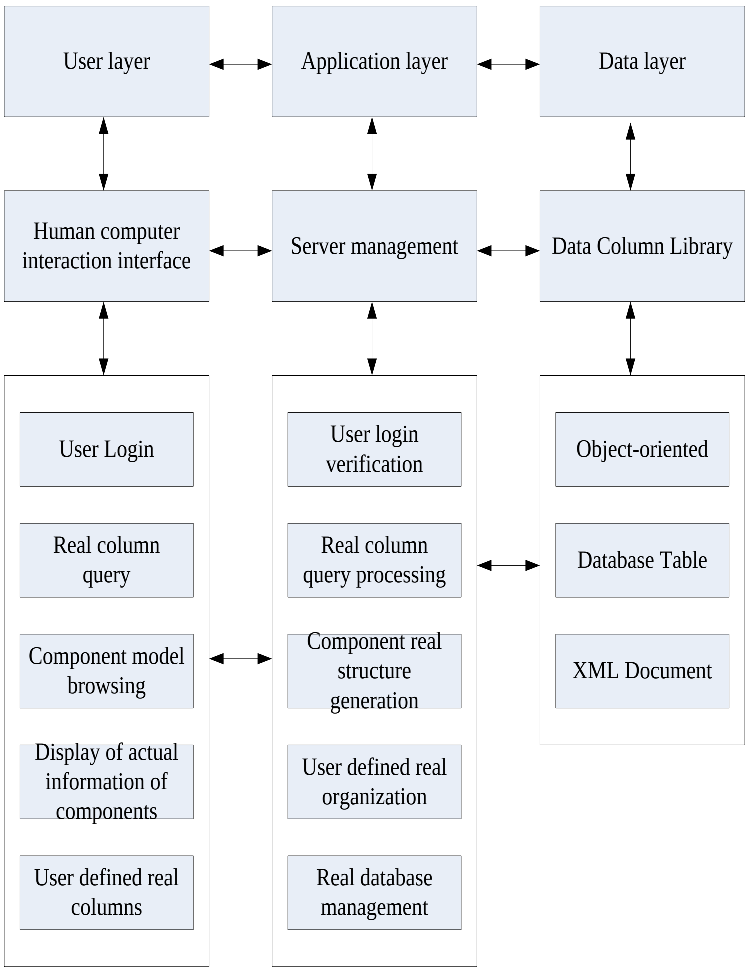

Figure 3. Frame diagram of perfection detection of engineering parts

The main purpose of this system is to verify and evaluate the perfection of the robot, and how to better evaluate its performance and find problems in the test. After the establishment of the product model (as shown in Figure 3), it is necessary to model and analyze it. Next, it is necessary to determine the interdependence between each part according to the actual situation, and finally import these data into the database through software to achieve whether the final result is consistent with the expected goal. This system is mainly based on the principle of combining artificial intelligence and construction machinery to build a complete simulation platform. This model can help users better understand the project quality and functional requirements, including product design, performance requirements, use environment, quality characteristics, and part surface roughness (such as size accuracy, shape accuracy, and other geometric feature values).

3.2. Functional Inspection of Parts and Components Perfection Test Model of Construction Machinery Products Based on Artificial Intelligence

During the functional inspection of the product part perfection test model of intelligent interactive robot, it is necessary to classify different types of part features, and determine whether they can be applied to practice according to the detected results. On the basis of constructing the 3D model of construction machinery products, the whole system is simulated and tested to verify whether the model has practical use value. The first is to establish a complete evaluation system. This evaluation system mainly includes design, functional modularization, quality inspection result analysis, inspection tools and methods, etc. In the design part, it refers to the cooperation, synergy and how to meet the requirements of cooperation among subsystems in the whole process.

4. Experimental Analysis of Part Perfection Test of Construction Machinery Products Based on Artificial Intelligence

4.1. Functional Inspection and Analysis of Parts and Components Perfection Test Model of Construction Machinery Products Based on Artificial Intelligence

Table 1 shows the function test data of the test model for the perfection degree of parts of construction machinery products.

Table 1. Functional testing of the perfection degree test model of the product parts

Test times	Number of product parts tested	Parts perfection test accuracy(%)	Parts test error rate(%)
1	562	96	4
2	572	90	10
3	586	95	5
4	537	94	6
5	522	96	4

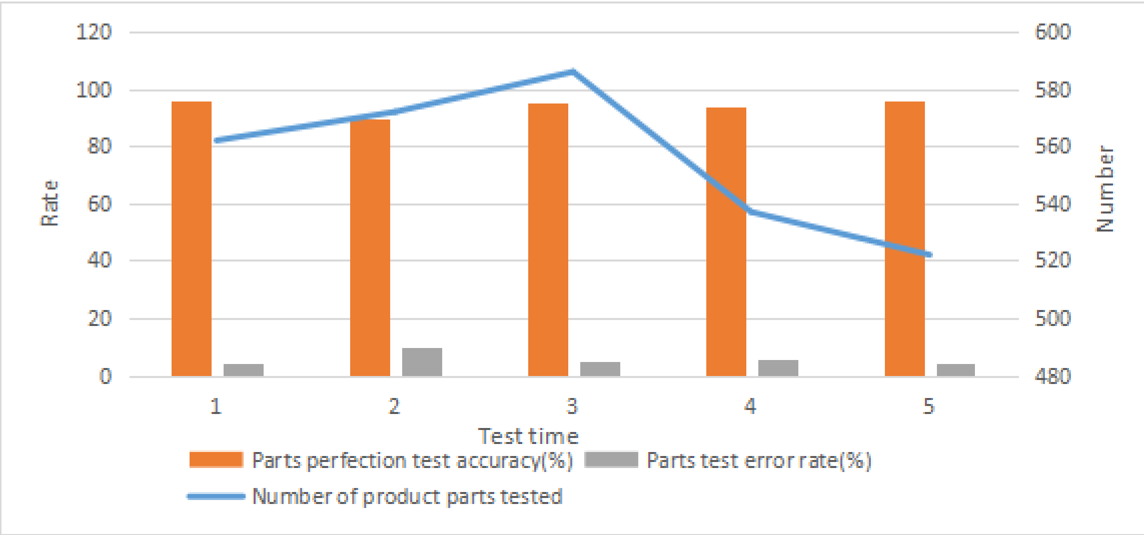

Figure 4. Perfect degree test function

After the system modeling is completed, each part of the system needs to be mapped one by one. Among them, the part structure, size parameters and assembly relations are described in detail. These contents are the most important, critical and difficult ones in the whole process, which are the assembly state variables. Other performance indicators, such as process flow, machining accuracy and detection methods, should also be described and defined one by one. At the same time, it also includes testing whether the model itself has good operability, that is, checking the accuracy of the system. It can be seen from Figure 4 that the accuracy of the model in detecting the perfection of product parts is as high as 90%, and the error rate is low. This shows that the testing performance of the model is excellent.

5. Conclusion

In this paper, the testing method for the degree of perfection of construction machinery parts in the field of intelligent manufacturing is studied in depth, and a new measuring method based on the combination of 3D solid model and modal analysis of construction machinery products under the artificial intelligence technology is proposed. This method can effectively solve the defects, incompleteness and inaccuracy of traditional quantitative measurement. It provides enterprises with a more objective, comprehensive and accurate measure of project quality indicators and evaluation tools, and is also conducive to the further development and progress of other related industries in the field of intelligent manufacturing, which is of great significance to the sustainable growth of China's social economy.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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