Algorithm Research and Implementation Based on Component Optical Detection System

Yongming She¹*
¹Henan College Of Industry&Information Technolog, 454000, Jiaozuo, Henan, China

*Corresponding author e-mail: kaifengll1@haut.edu.cn

Abstract. With the development of the times, gradually there is a new thing called electronic components born. Electronic components are collectively called components of electronic components and small machine instruments, such as diodes used in light bulbs. Components can be used in optical inspection systems, but they require some help from computer technology. Therefore, the purpose of this paper is to use algorithms to study component-based optical detection systems. After consulting the literature on components and optical detection systems, we analyzed the suitability of components and optical inspection systems by constructing different systems using a variety of algorithms. The experimental results show that the traditional ant colony algorithm is better than the AdaBoost algorithm and the genetic algorithm, so we finally choose to use the ant colony algorithm to construct the optical detection system.

Keywords: Components, Optical Detection System, Ant Colony Algorithm, Optimized Design

1. Introduction
Because the scale of China's electronic information industry is slowly expanding, especially after years of development, China has set up several more centralized industrial bases, and the current industrial chain has developed more perfect [1]. After more than 40 years of development, the output of resistor and other electronic materials in China has ranked first in the world[2]. However, there are also some shortcomings, that is, there is a surplus of medium and low-grade products, high-grade products cannot be developed by themselves, and they still need to be maintained through import. Because we do not have our own core technology, the scale of the enterprise is small and the profit is low [3].

With the production of components, in the production process, because of the huge number of components, there will always be defects [4]. For example, there are open circuit, short circuit and other defects on the printed circuit board, as well as fragmentation of diodes [5]. So, in order to find out this kind of defect and find out the problem, we have automatic optical detection technology [6]. It is a new technology. Its basic principle is to use optical imaging, such as camera and other photo forming systems to simulate human vision for imaging, and then use computer processing system to replace human brain for data processing. Finally, the results are fed back to the actuator, such as manipulator, to complete various tasks instead of human hands [7].
Because with the advent of the era of large factories, the number of products produced is huge, so the amount of production of the basic components of this instrument is also very large [8]. But there will always be some damage, and sometimes a small defect can lead to fatal results. So, in order to avoid this situation, we test all the parts made by the optical detection system, and then leave the qualified products, and study and analyze the unqualified products after finding out the reasons, so as to deduce which process of the production process has problems and solve them [9]. Therefore, the purpose of this paper is to use the algorithm to manufacture an optical detection system of related components [10].

2. Traditional ant colony algorithms

Ant colony algorithm is a bionic algorithm that simulates ant foraging, ants choose a path based on the transfer probability to leave pheromone, the greater the concentration of pheromones accumulated, the greater the probability that the path is selected, ants will find the optimal path based on the information remaining. According to the traditional ant colony algorithm, the chance of t ant k moving from node i to node j at some point is:

\[
\begin{align*}
    p_{ij}^{(k)}(t) &= \frac{\left[\tau_{ij}(t)\right]^\alpha \left[\eta_{ij}(t)\right]^\beta}{\sum_{s \in \text{allow}} \left[\tau_{is}(t)\right]^\alpha \left[\eta_{is}(t)\right]^\beta} & \text{if } s \in \text{allow} \\
    & = 0 & \text{otherwise}
\end{align*}
\]

Among them: for the transfer probability; For the t-moment information intensity between node i and node j; \( \alpha \) is the factor of information importance; For the expected heuristic function of node i to node \( \eta_{ij}(t) = \frac{1}{d_{ij}} \) is the Ethan distance from node i to node j; \( \beta \) is the desired degree factor.

After the ant completes a cycle, update the information on each path:

\[
\begin{align*}
    \tau_{ij}(t+1) &= (1-\rho)\tau_{ij}(t) + \Delta \tau_{ij}(t) \\
    \Delta \tau_{ij}(t) &= \sum_{k=1}^{\alpha} \Delta \tau_{ij}^{(k)}(t) \\
    \Delta \tau_{ij}^{(k)}(t) &= \frac{Q}{L_k}
\end{align*}
\]

Wherein: \( \tau_{ij} \) (t1) for the updated nodes i and j between the information intensity; \( \rho \) is the information in volatility coefficient; \( \Delta \tau_{ij} \) (t) is the increase of the information on the path node i to node j, and the initial \( \Delta \tau_{ij} \) (0) is 0; \( m \) is the number of ant colonies; \( Q \) is the information enhancer coefficient; The total length of the path that Lk has traveled for Ant k.

3. Experiment

3.1. Experiment preparation

Although components are experimental parts, but the market is basically available, so we can directly use off-the-go components. But optical testing systems require a professional laboratory to experiment, so we use the school’s lab for experiments with the school’s consent. We use components and algorithms to form optical detection systems and analyze their performance through computer manipulation.

3.2. Acquisition of experimental data

We use multiple sets of optical inspection systems to detect a wide range of components (all devices are detected from random spot checks in the population) to produce a large set of data. But not all of this set of data is useful, and we mainly select the products that fail to be tested. Because of this, we can find out the advantages and defects of each optical detection system, so as to have a better grasp of optical detection experiments.
4. Evaluation results

4.1. The results of the experiment are compared

|                      | Error rate | Missed detection rate | Retest rate |
|----------------------|------------|-----------------------|-------------|
| AdaBoost algorithm   | 1.6%       | 0.2%                  | 23.2%       |
| Genetic algorithms   | 1.7%       | 0.2%                  | 25.3%       |
| Ant colony algorithm | 1.3%       | 0.1%                  | 25.5%       |

According to the information given in Table 1, the gap between the three algorithms is small in error rate, missed rate and retest rate, and we know that the retest rate of all three algorithms is very low. The retest rate of genetic algorithm and ant colony algorithm is about 25%, but the retest rate of AdaBoost algorithm is only 23%. It shows that after the three algorithms re-check the products that were previously detected but have abnormalities, it is difficult to find the original errors and classify them as qualified products, which is prone to accidents. So, we mainly explore the main points checked by the ant colony algorithm.

![Figure 1](image1.png)

**Figure 1.** The main problem with checking nonconforming products

![Figure 2](image2.png)

**Figure 2.** The main problem with an abnormal product that was not detected

According to the experimental results of Figure 1 and Figure 2, it can be found that the optical detection system constructed by the ant colony algorithm is mainly to detect external defects of components, internal defects, light transmission problems, load caused by product non-conformity problems, but it is difficult to detect other problems such as noise dB, optical refraction, acid-base tolerance, temperature tolerance and other problems caused by the product is not qualified and
classified as qualified products. Then we found that the optical detection system constructed by the other two algorithms found that the genetic algorithm and the ant colony algorithm are somewhat in line with the AdaBoost algorithm, which mainly detects the problems of optical refraction, acid-base tolerance and temperature tolerance, but the external defects and loads caused by the two problems of non-conforming products difficult to detect, so we decided to put the two optical detection systems together for comprehensive testing. Experimental comparison found that its error rate fell to 0.2%, the missed detection rate fell to one in 10,000, but the retest rate rose to 142.7%, and the number of retests decreased by 70% compared to the original. So, we decided to put together two optical detection systems based on the AdaBoost algorithm and the ant colony algorithm to carry out comprehensive detection of components, so that the components can be the most reasonable detection.

4.2. Optical inspection

Optical detection technology is also known as AOI system integration technology. It mainly involves the composition of key devices, system design, hardware parts and software parts. We don't think about the hardware part at this point, we just think about the software part, which is to build the system through algorithms. The hardware composition of AOI requires image sensors, lens light sources, acquisition and pre-processing cards, computers, etc. These parts become an important part of the automatic optical inspection system. In many years ago, testing is generally through the human eye in the bright light of artificial testing, so that the body is not good, will affect health, and due to human error, will cause major defects, because the human eye is difficult to identify the internal defects caused by various problems. In recent years, with the development of the times, technology has steadily improved, high-speed image data processing and software development has become the core technology of AIO. Because AIO is through image detection, the image information of the device is constantly detected to obtain the information being measured. The amount of data is particularly large, so it needs to be analyzed by high-speed image data processing and excellent network transmission speed in order to get good data. It also requires a large number of storage systems, because the data is huge, the image data is too large, easy to cause the load.

AOI is a new type of optical inspection technology that has emerged in recent years, so many manufacturers have installed it for product inspection, but this is not enough. Because AOI systems are diverse, it is related to the products produced by various manufacturers, for example, some manufacturers are production components, and some manufacturers are the production of welding instruments. And components are also divided into a variety of, such as diodes, integrated circuit boards, lenses and other various instruments. And their detection methods are different. For example, diodes, it needs to be ultra-high temperature detection, the high temperature needs to be detected more than three thousand degrees, because tungsten filament melting point is more than three thousand degrees. But lenses and integrated circuit boards are no longer needed, and lenses and integrated circuit boards only need to detect 60 degrees of heat, because they do not need to work at high temperatures.

4.3. Components

Electronic components, which began to develop at the end of the 19th century and the beginning of the 20th century, developed most rapidly in the 20th century and are widely used as an indispensable basic component. In 1906, a vacuum tripolar tube, or tube, was discovered. Then a semiconductor tripolar tube was discovered in the late 1940s, replacing the tube. Then in the late 1950s, integrated circuits appeared, so that electronic products from large-scale began to gradually miniaturize, miniaturization development. Later there were large-scale integrated circuits and ultra-large-scale integrated circuits, making electronic products high-performance, low-consumption products. With the development of integrated circuits, great changes have taken place in various fields of scientific research and in the structure of industrial society. The first generation of computers have a room so large, and then gradually become the size of a notebook, and excellent performance improvement, and the existence of mobile phones, so that people's lives more convenient.
There are many device products produced by components, and here we briefly introduce several. The first is called a relay, which is a device with a control system and an output system between the electronic controllers. Generally used in automatic control circuits, it generally plays a safe role in the circuit. There are signal relays, solid state relays, temperature relays and other relays. The second is diodes. The diodes we use now are semiconductor diodes, also known as transistors. He is an electronic part that transmits current in one direction, generally with switching diodes, photodes, and many other diodes. The third is capacitors. It is a device that holds an electric charge. It is often used extensively in electronic devices and is generally used to control circuit and energy conversion. It generally has vacuum capacitors, infrared thermistors and other capacitors. Moreover, the classification of the capacitor is related to the medium contained in it, and the name is the way in which the medium contained in the middle of the capacitor is added to the capacitor. The fourth is the connector, which we commonly refer to as plugs and sockets. Its purpose is to transmit current or other signals, generally very common mobile phone chargers, electronic sockets, plug boards and so on. The fifth is the locator. is the variable resistor used to split the voltage? There is generally one-knife double-throw switches and other inductive devices. The sixth is one of the components of our modern life, integrated circuits. It is an important factor in the progress of the electronic society, because of the emergence of integrated circuits, all large electronic devices began to small electronic, miniaturized development. For example, computers, televisions, mobile phones, etc. And electronic components have special materials, such as capacitor materials, semiconductor materials, as well as signal shielding materials, vacuum electronic materials and other special materials. Then in the electronic components, all kinds of devices have their own unique symbols and their own set of parameters, due to the different manufacturers, their parameters are not marked in the same way. So, we need to look carefully when we use it to prevent it from being used incorrectly, with the wrong consequences. Therefore, before using, we need to understand the parameters of the instrument, and then the required instrument to choose. In order to prevent the wrong parameters and cause current overload and other electrical facilities safety problems, resulting in injury.

5. Conclusion
In summary, we use the ant colony algorithm construction system and other algorithm construction system to compare the analysis and come to the experimental conclusion: a good optical detection system, can not achieve 100 percent detection success rate, and the difference between them that fault tolerance is not large. So, we have to set up at least two optical detection systems, after two screenings to reduce our overall error rate to improve the overall success rate, and use two different algorithms to construct different systems to work best together. Because the results of the system constructed by the same algorithm are consistent, the original error still exists.

References
[1] Roberts M I. The probability of unusually large components in the near-critical Erds–Rényi graph[J]. Advances in Applied Probability, 2018, 50(01):245-271.
[2] Deepak P, Nisha M, Mohanty S P, et al. Everything You Wanted to Know About the Blockchain: Its Promise, Components, Processes, and Problems[J]. IEEE Consumer Electronics Magazine, 2018, 7(4):6-14.
[3] Li X Y, Huang H Z, Li Y F, et al. Reliability assessment of multi-state phased mission system with non-repairable multi-state components[J]. Applied Mathematical Modelling, 2018, 61(sep.):181-199.
[4] King D L, Herd M C E, Delfabbro P H. Motivational components of tolerance in Internet gaming disorder[J]. Computers in Human Behavior, 2018, 78(jan.):133-141.
[5] YUXI, WANG, ZHAOKUN, et al. Dielectric metalens-based Hartmann–Shack array for a high-efficiency optical multiparameter detection system[J]. Photonics Research, 2020, v.8(04):59-66.
[6] Cheng, Lin, Liao, et al. Trace Gas Detection System Based on All-Optical Quartz-Enhanced
Photoacoustic Spectroscopy. [J]. Applied spectroscopy, 2019, 73(11):1327-1333.

[7] Lv G, Chen S. Routing optimization in wireless sensor network based on improved ant colony algorithm[J]. International Core Journal of Engineering, 2020, 6(2):1-11.

[8] Yin S, Zhu M, Liang H. Multi-disciplinary design optimization with variable complexity modeling for a stratosphere airship[J]. Chinese Journal of Aeronautics, 2019, 32(05):191-202.

[9] Hassanalian M, Salazar R, Abdelkefi A. Conceptual design and optimization of a tilt-rotor micro air vehicle[J]. Chinese Journal of Aeronautics, 2019, 32(02):159-171.

[10] Yang X, Kim Y Y. Topology optimization for the design of perfect mode-converting anisotropic elastic metamaterials[J]. Composite Structures, 2018, 201(OCT.):161-177.