

## Research Article

# Application of Computer Vision in Intelligent Manufacturing under the Background of 5G Wireless Communication and Industry 4.0

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With the development of 5G wireless communications and the arrival of Industry 4.0, computer vision has further penetrated the manufacturing sector. This paper makes a comprehensive study on the field of intelligent manufacturing. By constructing a model analysis method, the current situation of computer vision intelligent manufacturing under the background of 5G wireless communication and industry 4.0 is comprehensively analyzed. It is found that today's computer vision technology is developing rapidly, while the Industry 4.0 stage and 5G communication technology have helped the field of intelligent manufacturing. At the same time, the author deeply analyzes the characteristics of intelligent manufacturing enterprises supported by computer vision and finds that it has the problem of unbalanced distribution of enterprises. After that, the author demonstrates the application of computer vision re-intelligent manufacturing from multiple dimensions. The application of computational optimization methods provides more diverse and comprehensive algorithms for labor saving and resource utilization improvement. Computer vision technology drives and promotes the development of intelligent applications and promotes a more comprehensive development of intelligent manufacturing.

## 1. Introduction

The industrial 4.0 era means that products and services will be based on big data, Internet of things, and artificial intelligence technology, through the combination of software, hardware and environment, to produce new products and services, completely different from the traditional production mode of intelligent manufacturing mode. Industry 4.0 is an upgrade in the industrial 3.0 stage. Industry 3.0 refers to the rise of Internet of Things, big data, artificial intelligence and other technologies. Industry 4.0 is developed and applied on the basis of industry 3.0. Industry 4.0 brings opportunities for enterprise intelligent manufacturing. A prominent feature of Industry 4.0 is intelligent manufacturing. Big data, Internet of Things, artificial intelligence and other technologies are the technical support for the development of Industry 4.0. It is also the core driving force for the development of intelligent

manufacturing. The core of the Internet of things is to realize the interconnection of all things, through the connection of things to connect the information fortress between things, to realize the interconnection of all things. Big data has the ability to analyze massive amounts of data, analysis of massive amounts of data generated in the process of intelligent manufacturing. Artificial intelligence, which gives human thinking to machines, promotes the intelligent transformation of manufacturing industry. The intelligent production workshop and intelligent decision-making system constructed by the Internet of things, big data, artificial intelligence and other core technologies have greatly promoted the transformation and development of intelligent manufacturing industry. In the enterprise's specific production, parts assembly, disassembly sequence can be improved by intelligent algorithms production team efficiency. For example, Matt used genetic algorithms to implement an enterprise intelligent assembly sequencing method. There

are also many challenges in developing Industry 4.0. In the context of Industry 4.0, there may be challenges such as information leakage. But the opportunities of Industry 4.0 outweigh the challenges [1–3].

Haier is a pioneer in the development of intelligent manufacturing. It takes the lead in improving business models, introducing technologies such as the Internet of Things and artificial intelligence, and building a series of industrial models. Now, Haier is intelligent manufacturing practice has a certain development results. Its business model has changed from mass manufacturing to mass customization, building a smart life platform, and transforming foreign enterprises from producing product hardware to providing smart solutions; internally integrate user fragmentation requirements and achieve personalized customization through interconnected factories. Many of Haier's products are produced by supporting customized housing affairs. For example, TianPing Air Conditioning is produced through user creation. Traditional air conditioning is square, platinum air conditioning is round, structure like bird's nest-like. Users put forward ideas online, hoping that air conditioning can achieve such an effect, and ultimately this product has received a lot of support.

With the rise of 5G technology and the arrival of Industry 4.0, computer vision has become an important driving force for the development of intelligent manufacturing. In order to further promote the development of intelligent manufacturing, it is necessary to accurately analyze the role of computer vision in the field of intelligent manufacturing. In this paper, through the rise of China's technology in the era of Industry 4.0, such as the Internet of Things and artificial intelligence, the application framework of computer vision is built to promote the wide application of computer vision technology. Computer vision technology design is applied in various fields of intelligent manufacturing industry, covering computer computing, artificial intelligence signal processing, automatic design and autonomous learning, graphics and image processing and other fields. [4, 5]. Promoting the application of computer vision in the field of intelligent manufacturing can improve the quality and efficiency of manufacturing products and achieve steady growth in manufacturing output [6, 7].

Nowadays, the development of intelligent manufacturing not only pursues economic benefits, but also considers ecological benefits. Development is infinite, but our ecological environment is limited. A good business model not only to ensure the healthy development of enterprises, but also to enable enterprises to continue to develop. In the process of developing intelligent manufacturing in enterprises, green sustainability is a factor that cannot be ignored [8–10].

The purpose of this paper is to promote the development of enterprise intelligent manufacturing with the help of computer vision technology in the background of industry 4.0 and 5G communication. The purpose of this paper is closely related to the Internet of Things, artificial intelligence technology and 5G communication technology under the background of Industry 4.0. The Internet of Things makes things interconnected in intelligent manufacturing. Artificial

intelligence plays an important role in intelligent production and intelligent decision-making. 5G provides technical support for information communication in all aspects of intelligent manufacturing. This article carried out on the basis of previous studies, on the whole there are both breakthroughs and shortcomings. The research content of this paper is not deep enough, and the investigation is not enough. However, on the basis of previous studies on industrial 4.0 and 5G communication technology under the background of intelligent manufacturing theory sent support, trends, methods of analysis more thorough. The induction of the theory in this field is the novelty of this study.

## 2. Computer Vision Technology to Promote the Development of Intelligent Manufacturing

*2.1. Basic situation of computer vision technology.* With the widespread popularization of 5G wireless communication networks and the advent of the industrial 4.0 technology era, the widespread application and continuous prosperity of computer vision technology have also brought a new technical foundation. In the context of the continuous improvement of industrial productivity requirements, based on computer vision technology, productivity improves, improves the production level of various production departments, improves the efficiency of data collection processing, and greatly improves the intelligent level of machines [11]. Since the 1950s, computer vision technology has entered a new stage of development through the use of intelligent production in the field of intelligent production, which has entered a new stage of development and promoted the steady improvement of various productive forces. In the process of comprehensive research on production methods and development models, we found that the widespread promotion of computer vision technology has an important role in improving the efficiency, methods, and optimizing the utilization of resource utilization in the field of intelligent manufacturing [12]. At the same time, the extensive promotion of computer vision technology has brought new concepts of development [13, 14]. In Figure 1, the domestic computer vision application market share was investigated in 2021.

*2.2. New development prospects brought by the field of intelligent manufacturing.* With computer vision technology, the new development model brought by intelligent manufacturing has promoted the comprehensive innovation of computer vision technology in the field of industrial production [15]. With the continuous prominent concept and new theory, computers visual technology has achieved a new production and development model update in the process of integrating industrial production development technology. In different development processes, a new productive development has been promoted. In the 1980s and 1990s, computer vision technology promoted the comprehensive promotion of development in the field of intelligent manufacturing [16]. By integrating more comprehensive computer vision technology with network nerve

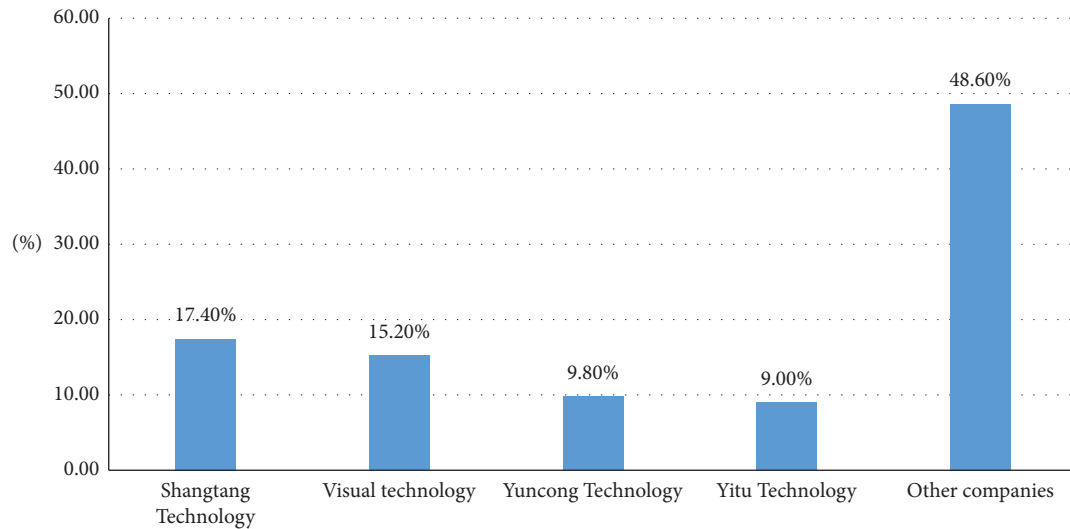


FIGURE 1: 2021 domestic computer vision application market share.

technology, it effectively promoted the new development of the field of intelligent manufacturing. With the development of the production technology and processes in the field of intelligent manufacturing, the production technology and processes have promoted the improvement of the efficiency of the entire process of intelligent manufacturing. In this process, computer vision technology has played a positive role in the optimization of the data collection process. At the same time, in the process of promoting the integration of computer vision technology and industrial production, the exposed problems, after intelligent identification and solution, make the development of the industrial industry more efficient and enter the era of new intelligent development [17, 18]. The development of the field of intelligent manufacturing has driven and promoted the improvement of productivity in the entire industrial field, greatly enhanced the utilization of resource utilization, and reduced pollution to the natural environment. It has taken a road of green, ecological, low-carbon, and sustainable development [19, 20].

Computer identification has brought great benefits to intelligent manufacturing, which can improve the production efficiency and production level of enterprise teams. For example, in the machine assembly process and quality inspection. Assembly is to realize the connection of mechanical parts or components according to the requirements of drawings, and combine mechanical parts or components into machines. Mechanical assembly is an important part of machine manufacturing and repair. The quality of assembly work plays a very important role in the efficiency of the machine, the duration of repair, the labor and cost of the work. Many companies use computer vision to track their machines and assembly operations in real time. For example, ZDT software produced by FANUC is a preventive maintenance software for capturing images from cameras installed on robots. These data are then processed to provide fault diagnosis and detect any potential problems. Quality inspection is a process of checking, measuring, measuring and testing one or more characteristics of products or

services according to standards or regulations through necessary and qualified inspection workers, measuring tools, instruments and equipment, and comparing the data or results of inspection with the requirements of standards or regulations to determine whether they meet the requirements. It is a quality basis for monitoring product manufacturing and judging whether product quality and service quality meet the standards and regulations. Content and function of quality inspection. Use computer vision to monitor packaging and product quality to reduce the generation of defective products. Improve the efficiency of enterprise production.

### 3. The Characteristics of the Development of Intelligent Manufacturing under Computer Vision Technology

*3.1. The degree of technology patented by the computer vision industry is high.* Throughout the world, in the field of computer vision technology, countries such as Germany and Japan are taken as examples. In the computer vision industry, during the survey of technological patent level, we found that the development of computer vision technology is relatively high in patent applications in countries and regions earlier, with a large number of patented technologies. In the process of using patented technology in other regions and countries, to a certain extent, it restricts the optimization of industrial assets in the country and region. Therefore, under the premise that my country's computer vision technology starts late, in order to better realize the extensive and far-reaching development of computer vision technology, it is necessary Innovation and development will achieve effective promotion and driving for industrial intelligence economy [21, 22]. In Figure 2, the development trend of China's computer vision industry in 2016-2021.

Refer to the specific data Wang Tiesheng' computer vision technology development and application [23].

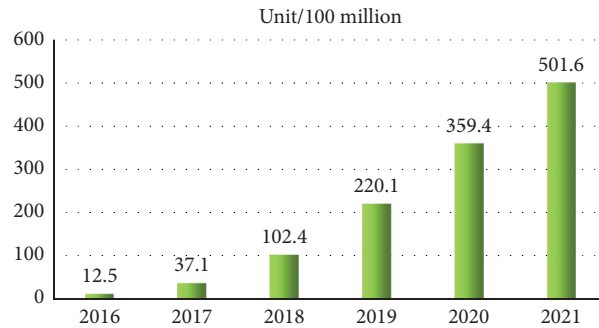


FIGURE 2: 2016-2021 China's market scale development trend.

At present, it can be seen from Figure 2 that computer vision has developed well in many fields. Although these manufacturing applications are different, the pattern of development of computer vision in various industries is the same. The specific mode is shown in Figure 3.

**3.2. Computer Vision Technology Promotes the Development of Intelligent Project Application.** In the process of computer vision technology, in the field of intelligent manufacturing, it effectively drives and promotes the new development of industrial productivity, promotes the continuous improvement of industrial productivity levels, and proposes a new development model for the development path of the 4.0 era of Industry 4.0. With the new development of intelligent productivity, 3D vision is newly applied to the era of Industry 4.0, so that more data collection is obtained, and more industrial production factors are organically integrated, and more industrial production factors are organized. Intelligent screening and analysis of a large amount of data, the accurate development direction and production development model are obtained to promote and drive the new development concept of Industry 4.0. In Figure 4, the proportion of development directions in the application field of artificial intelligence projects in computer vision design in 2021 [24, 25].

**3.3. Computer Vision Technology Promotes the Core Value of Industry.** In the process of computer vision technology, in the field of intelligent manufacturing, with the application of different fields and different stages of industrial production, it reflects the promotion and driving role of computer vision technology. During the application of computer vision technology to the mid-to-high-end industrial production market, it has been occupied by more developed countries such as Germany and Japan. In most developing countries led by our country, with the continuous innovation and drive of the core development concept of computer vision technology, it has promoted the continuous accumulation of the technical foundation during the entire production chain, realizing computer vision technology, and in intelligent manufacturing in intelligent manufacturing The widespread development and drive of the field have greatly improved production

efficiency, improved resource utilization, optimized the distribution of labor, and steadily improved the level of productivity. At the same time, the development of computer vision technology is promoted and the entire core value of the industrial chain has effectively improved. In Table 1, the angle comparison of human vision and computer vision is as follows [26, 27].

**3.4. Computer vision technology promotes the intelligent development of industry.** With the widespread development of computer vision technology, the advanced technologies of advanced machine vision manufacturing are integrated, which greatly improves the integration of technology and customer service quality. In different fields, in the process of extensive development, it provides more comprehensive and more efficient solutions for intelligent manufacturing. At the same time, the prosperity of 5G wireless communication networks allows computer vision technology to bring in major domestic industrial production areas. Effective industrial expansion. With the continuous development of computer vision technology, it has brought new investment opportunities to major industries, and core technology and limited resources have complemented the integrated development, promoting the process of computer vision technology, and promoting the widespread development of intelligent manufacturing fields. Among them, a broader and diverse development trend has brought about the improvement of the benefits of major enterprises and companies within the industry. At the same time, it has strongly replaced imported products, which has brought about the new computer vision technology innovation and innovation development [28, 29].

## 4. The Application of Computer Vision Technology in the Field of Intelligent Manufacturing

**4.1. Computer vision technology to promote the development of artificial intelligence technology.** In the process of the widespread development and continuous innovation of computer technology, it has effectively promoted and promoted the continuous application and expansion of artificial intelligence technology, and promoted and promoted all aspects of the field of industrial intelligence manufacturing. With more efficient technical means, the productivity of

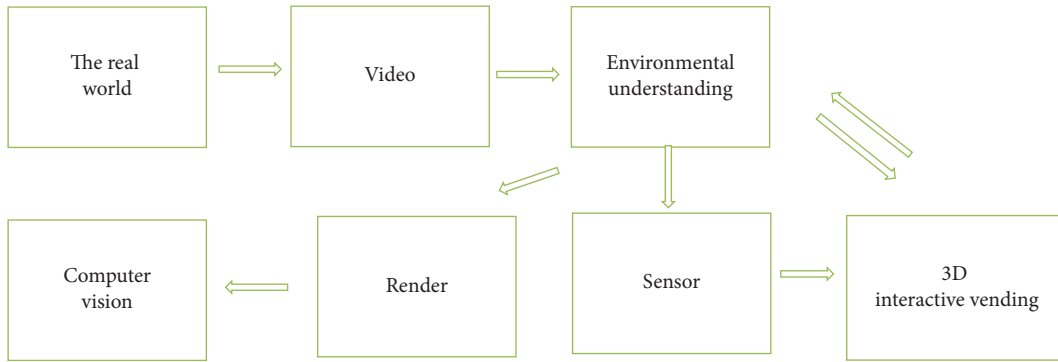


FIGURE 3: Application mode of computer vision in multiple manufacturing applications.

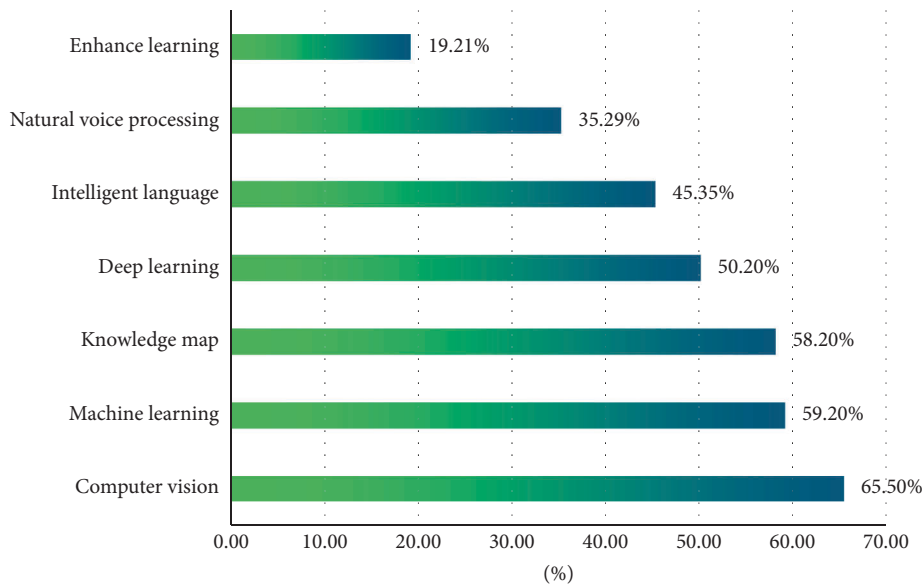


FIGURE 4: The development direction of the application field of artificial intelligence projects in computer vision design in 2021.

different industries in China has been improved, and the more comprehensive development of electronic products, clothing manufacturing, and services has been promoted. At the same time, computer vision technology has brought motivation to the development and update of artificial intelligence technology, enhanced more corporate benefits, and the development of the field of intelligent manufacturing is more comprehensive in the context of Industry 4.0.

In the field of driving and promoting industrial intelligent manufacturing, in the process of long-term construction and development, the production factor of modern factories is integrated and the purpose is to standardize production. The comprehensive and accurate manufacturing expansion in the field of mechanical manufacturing will effectively obtain resources information, and scientifically use natural resources to increase industrial output ratio. In the process of industrial 4.0, more efficient computer vision technology has been used to drive and promote the comprehensive improvement and development of the field of intelligent manufacturing. The new development concept is driven and promoted. In the process of industrial

production, the production efficiency is continuously optimized and production is improved to improve production. Effects make in the field of traditional mechanical manufacturing, through the application of intelligent manufacturing methods and methods, optimize the industrial production process and greatly improve production efficiency. Through the application of computer vision technology to the field of intelligent manufacturing, it greatly improves production efficiency and improves the work progress of various production lines. Informatization technology promotes productivity improvement, becomes the field of intelligent manufacturing, and has a more vivid development direction [30, 31].

The application of computer vision technology has driven and promoted the widespread development of the intelligent manufacturing industry in the context of Industry 4.0. Let the comprehensive visual system technology be applied to the field of intelligent manufacturing, and provides a clear development direction for industrial development and productivity improvement with more comprehensive development and clear development positioning. In the process of building a clearer smart

TABLE 1: The comparison between human vision and computer vision.

Number	Project	Artificial vision	Computer vision
1	Accuracy	The resolution is greater than 100 microns	Observe micron level
2	Speed of work	Speed less than 40m/s	Observation speed is high
3	Adaptability	Environmental adaptability is not strong	Strong adaptability to the environment
4	Objectivity	Data deviation	Data are more accurate
5	Repetitiveness	Fatigue cause errors	Strong sustainability
6	Reliability	Receive artificial emotional influence	Stable job
7	Work efficiency	Low efficiency	Efficient

manufacturing development goal, by improving the utilization of natural resources and technological innovation, effectively integrating and coordinated development, driving and promoting computer vision technology, solving the shortcomings of high efficiency in industrial costs, and lack of time consumption. The cost of labor is greatly reduced, so that modern intelligent manufacturing industrial technology is fully applied. Table 2 investigated the proportion of Chinese computer vision enterprises from 2017-2021.

#### 4.2. Computer vision technology drive and promote industry

*4.0 construction.* The new application of computer vision technology has driven and promoted the development and development of mechanical integration, so that the field of industrial production, innovative construction in intelligent manufacturing development, allowed industrial 4.0 construction and development, and entered a new stage of development. From the aspects of control and management of various industries and the control of various processes, injecting a new driving force into the innovation and development of computer vision technology, the optimization of various production processes in the process of focusing on the improvement of production efficiency has enabled major production processes, so that computer vision technology is made in computer vision technology Application development is more diverse. The efficiency of the intelligent manufacturing field has been greatly improved, and the opposite drives the continuous optimization of visual technology. In the process of innovation and development, due to the high efficiency of its visual technology and the great improvement of production efficiency, it has driven and promoted a new construction of the construction and development of industrial 4.0, and promoted and promoted Industry 4.0 with more comprehensive development methods and innovative development concepts. Construction and development. In the use of computer vision technology, many factories that promote development, through the use of computer vision technology, continuously optimize visual algorithms, and optimize and upgrade in the field of computer mathematics technology control. In Table 3, the proportion of financing in the global computer vision application segmentation in 2021.

*4.3. Optimization processing of computer visual technology algorithm.* During the development of computer vision technology, based on the continuous optimization of algorithms, the development of intelligent manufacturing is

TABLE 2: 2017-2021 The proportion of Chinese computer vision enterprises.

Number	Business field	Proportion
1	Industry	32.10%
2	Medical Treatment	15.10%
3	Smart City	11.10%
4	Retail	8.10%
5	Common Technology	7.30%
6	Security	4.80%
7	Public Security	5.10%
8	Government Affairs	2.50%
9	Finance	1.90%
10	Transportation	1.80%
11	Smart Home	1.70%
12	Office	1.50%
13	the Internet	1.60%
14	Energy	1.40%
15	Marketing	0.90%
16	Media	0.90%
17	Electricity	0.80%
18	Environmental Friendly	0.70%
19	Agriculture	0.50%
20	Judicial	0.20%

more diverse. By building a clearer development model, constantly optimize the algorithm, innovate the production process and production factors, fine control, and other methods to reduce labor costs Computer visual technology algorithms, in the process of optimization, promote and promote comprehensive efficiency improvement in the field of intelligent manufacturing. Through the effective detection and processing of production data during the production process, the intelligent algorithm is used to perform accurate process control, which greatly saves labor costs, replaces traditional production models with more efficient production methods, and is suitable for modern production requirements.

By constructing an optimization algorithm in the field of intelligent manufacturing, based on computer vision technology, the edge computing model of the production node is effectively optimized, and a more accurate target function is proposed:

$$P = f_{\text{exit}}(x; \xi), \quad (1)$$

where  $\xi$  is the optimization factor and  $x$  is the item to be optimized.  $f_{\text{exit}}$  is a special function  $P$  represents the objective function.

TABLE 3: 2021 Global Computer Visual Application Segmentation Fresh Performance.

Number	Segmentation	Financing situation/100 million yuan
1	Computer deep learning	27.8
2	Computer vision development	24.4
3	Smart robot	18.3
4	Intelligent gesture control	15.25
5	Voice input processing	14.25

The constructed function model is determined by various influencing factors in the industrial production process based on neural network analysis methods, and the judgment results are constructed as follows:

$$\bar{K} = \text{softmax}(P) = \frac{e^P}{\sum_{P \in C} e^P}, \quad (2)$$

where  $P$  represents the objective function,  $e$  is the natural logarithm, and soft max is a special function that takes the largest proportion of factors.

Based on the above-mentioned state judgment target function, the computing loss function of different production nodes during the production process is as follows:

$$D_n(\bar{K}, P, \xi) = \frac{1}{|C|} \sum_{c \in C} K \log \bar{K}, \quad (3)$$

where  $K$  represents different nodes, and  $C$  is a set of influence factors. Formula (3) is the optimization of the edge computing model of the production node. Formula (1) proposes the optimization objective function, and Formula (2) constructs the judgment result. (3) calculates the computational loss of different production nodes in the production process. The above three formulas can effectively optimize the edge computing model of production nodes.

Through the application of the above calculation and optimization method, the intelligent manufacturing of the application of computer vision technology has been greatly deepened. Through the optimization of algorithms, the entire matrix algorithm is optimized, because the application of different development stages and technical means is extremely great. It has improved production efficiency and provides more diverse and comprehensive algorithms for labor saving and resource utilization [32, 33].

**4.4. Wide integration of computer vision technology.** In the process of computer vision technology efficiently, the production and development departments need to conduct comprehensive investigations on the actual situation of industrial production efficiency, and give more comprehensive computer vision technology application data support. By constructing a clearer and comprehensive development process, for computer vision technology, and the application of intelligent manufacturing fields, build a more comprehensive development prospect. Due to the more comprehensive application development of computer vision technology in terms of image application processing, the application and integration of the two key technologies of image collection and image analysis and processing

through computer vision technology, so that in the intelligent manufacturing process, based on computer vision technology-based images Collect applications to effectively collect and summarize a large amount of data.

In the process of integrating the two key technologies of computer vision technology, on the one hand, we must pay attention to improving the speed, quality, and accuracy of image collection, supporting more accurate and efficient data collection technology as a support, and for computer vision technology to carry on the images. Treatment analysis and provide a solid data foundation. On the other hand, based on optimized algorithms, the intelligent manufacturing technology foundation obtained by computer vision technology, continuously optimizes the processing process during the processing and analysis of the image, effectively screening and organic integration of the image, and continuously optimize the data collection standards. With more efficient data processing methods, the entire production process is optimized to improve the overall efficiency of the production line. Through image processing software, the optimization processing of images and the screening of key parts, effectively promoting and driving the effective integration and long-term development of the two key areas in the two key areas of computer vision technology.

**4.5. The future development trend of computer vision technology.** Based on the background of 5G wireless communication networks and Industry 4.0, the development and application of computer vision technology has a clear direction of development. In the process of promoting and promoting the development of intelligent manufacturing, it has a new development trend. Using intelligent robots to integrate into the process of industrial production process, through optimized algorithm control, reasonable use of industrial production efficiency and production resources, to promote and promote the efficiency of intelligent manufacturing efficiency. With the continuous optimization of algorithms, in the process of computer vision technology in the future, it is mainly concentrated in the following two development aspects. First, in the process of optimizing the image, computer vision technology, based on more efficient and accurate computer vision algorithms, continuously optimize the algorithm, more accurate process control, and attach more importance to the maturity of technology application. Second, in the field of intelligent manufacturing, more efficient computer vision technologies are applied to intelligent manufacturing methods such as strong applicability, high work efficiency, and strong work stability in the

production process to carry out high-efficiency applications, improve the overall analysis processing speed of the system, and in intelligent manufacturing in intelligent manufacturing. In the context, the continuous optimization of production processes, improving the overall stability and safety of the production line, and eliminating the impact of major influencing factors.

## 5. Conclusion

Under the background of a more comprehensive development of 5G wireless communication networks and more comprehensive construction of industrial 4.0, computer vision technology, applied to the field of intelligent manufacturing, its more optimized algorithm and more accurate analysis and processing capabilities, for the development of intelligent manufacturing and the improvement of resource utilization has brought new development prospects. This article conducted a wide range of investigations in the development status of computer vision in the field of industrial 4.0 in the background of Industrial a wide range of development status of different levels of computer vision technology at home and abroad, and did a comprehensive research. The study build a more accurate and efficient computer vision technology algorithm model. Based on different development concepts and different production model conditions, effective technological innovations have been carried out to drive and promote long-term development of the field of intelligent manufacturing.

In the process of computer vision technology, it is applied to the field of intelligent manufacturing, because of the development of industrial production, the effective application of computer vision technology can greatly reduce production costs, improve the utilization of production factors, greatly saves labor costs, and for industrial productive forces. Improvement provides important technical guarantees. At the same time, the development of intelligent manufacturing has certain deficiencies and disadvantages. The optimization of computer vision technology and the fusion of technology are still the key areas of long-term attention and continuous innovation and development in major countries and regions in the future.

Studying the impact of computer vision on intelligent manufacturing in the context of 5G communications and Industry 4.0 can theoretically promote the development of China's manufacturing industry, improve manufacturing productivity, promote China's economic development, and accelerate China's goal of becoming a manufacturing power. In practice, through computer vision technology to achieve automatic appearance defect detection, parts assembly, etc., these have become the preferred solution for various enterprises, and have also achieved mature applications in various subdivisions. On the one hand, it greatly improves the efficiency of detection and production. On the other hand, it reduces the labor cost of enterprises and truly improves the productivity level of enterprises.

This article draws lessons from the lack of theoretical analysis of previous articles and analyzes the theoretical basis

of the article from multiple levels. However, this article also has the problems of insufficient research data and deep research.

This article is based on previous studies, coupled with its own innovations, such as the optimization of computer vision algorithm technology. The comprehensive theoretical summary in the field of intelligent manufacturing is also the highlight of the article. However, the research on innovation and green development concept is not deep enough. It is hoped that future research can develop towards green manufacturing and innovative manufacturing [34, 35].

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that they have no conflicts of interests.

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