# *The Development and Application of Computer Vision Technology in The Era of Artificial Intelligence*

**Siwen Wang[1,a], Xiongwei He[1,b,*]**

*[1]Shanxi Agricultural University, Jinzhong, Shanxi, China*
*[a]w1574460812@163.com, [b]528817030@qq.com*
*\*Corresponding author*

*Keywords:* Artificial intelligence, computer vision technology, development trend, application

*Abstract:* With the increasing popularity and wide application of Internet technology, the computer field is in the stage of vigorous development, the world is moving towards the economic development period dominated by information industry. In recent years, with the birth of the emerging field of artificial intelligence, which solves problems that traditional computer technology can not solve, more and more people have a strong interest in it and devote themselves to this research, making artificial intelligence has evolved into a mainstream discipline in the field of computer. As one of the core technologies of artificial intelligence, computer vision has made remarkable progress in theoretical research and technical application, and has been widely used in home furnishing, medical treatment, network and security. This paper mainly introduces the concept and relationship between artificial intelligence and computer vision, discusses the main technology and application scenarios of computer vision, and proposes a vision for the future development.

## 1. Introduction

In the era of rapid development of information, science and technology are making continuous progress, and artificial intelligence technology has emerged at the historic moment. The development of artificial intelligence is not only leading the progress of human society, but also the foundation of the era of human intelligence. The deep application of artificial intelligence technology in human work, production and life has derived a series of new industries. Among them, computer vision technology is the most typical representative. It combines both software and hardware, with other elements such as algorithms, sensors, displays and lens equipment. Computer vision technology can recognize not only graphic information, but also body movement information. Under the historical background of the great development of artificial intelligence technology, it has significantly promoted the progress of human civilization, overcome the technical difficulties in engineering, and brought more convenience to human life.

Scientific research has confirmed that more than 80% of the body's sensory input comes from the visual system. We often use vision to observe objects and environments and obtain relevant information. Vision is an important, basic ability for ordinary people. However, the process and mechanism of the function accomplished by the visual process are very complicated. Some

scientists point out that vision itself contains all the basic elements of thought or intelligence. [1]

## 2. Artificial Intelligence and Computer Vision Technology

### 2.1. Understanding of Artificial Intelligence

Artificial Intelligence, or AI for short. It is a brand new technical science that studies and designs concepts, methods, skills and application patterns for simulating, extending and expanding human intelligence. Wikipedia explains: "Artificial intelligence, also known as machine intelligence, refers to the intelligence displayed by machines made by humans." The more far-sighted and insightful answer is: ARTIFICIAL intelligence = technology + applications. In this context, technology is generally used to refer to any technology that "enables machines to mimic basic human capabilities." In general, an important task of artificial intelligence research is to enable computers to perform some complex tasks that normally only human intelligence can perform.

### 2.2. Understanding of Computer Vision Technology

Computer Vision (CV) is a discipline that studies how to make computers "see" like human eyes, so that computers have the observation and discrimination ability like human eyes. More precise, it refers to the use of video cameras and computer replace the human eye, make the computer is similar to human to identify objects, segmentation, classification, tracking, and graphics processing, discriminant decision-making ability, and makes computer processing is more advantageous to the human eye observation and passed to the detection of image instrument. Based on this concept, the main goal of computer vision is the expression and cognition of the environment, the core problem is to study how to organize the input image signal, to distinguish objects and scenes, and then to understand the image content correctly.

As a new discipline, computer vision researchers try to build an artificial intelligence system to extract "information" from multi-dimensional data of images by exploring related technologies and methods. An important research goal is to enable computers to understand three-dimensional spatial information and data using two-dimensional graphics. Research field of computer vision is a comprehensive, generally include computer science and engineering, signal processing, biological physics, applied mathematics and statistics, neurophysiology, and cognitive science, etc., at the same time with the graphic information processing, pattern recognition, projective geometry, data reasoning, computational mathematics and other fields are closely related. In recent years, in computer graphics, three-dimensional display technology and other fields have also generated a strong cooperative relationship.

### 2.3. The Relationship Between Artificial Intelligence and Computer Vision Technology

Computer vision is closely related to artificial intelligence, but there are also fundamental differences. The purpose of artificial intelligence is for computers to see, hear and read. Graphics, speech and word processing are the three basic components of our current AI. But in all fields of ARTIFICIAL intelligence, machine vision is the core technology. As we all know, vision accounts for 80% of the total sensory input of the human body, and it is also the most difficult part of the human body to perceive. So if artificial intelligence is a revolution, it will have its roots in computer vision, not any other technology.

First, computer vision is the most critical problem that artificial intelligence must solve. Because visual information is much more critical than hearing and touch, 70% of the activities of human cerebral cortex are processing visual information, so if the lack of visual information, the whole

artificial intelligence is just an empty frame, can only do symbolic reasoning.

Second, computer vision is by far the most powerful driver of ARTIFICIAL intelligence. Because of its many applications, many technologies are developed in computer vision, but also applied to the field of AI.

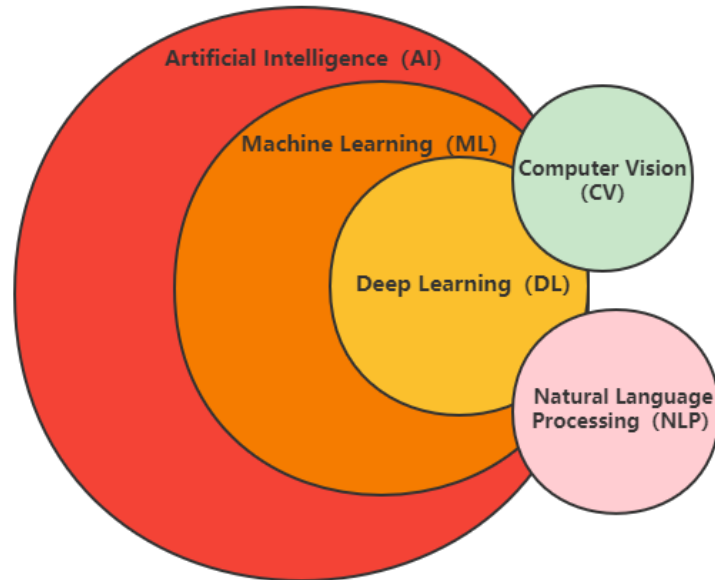Third, computer vision system has a rich application background of quantum AI.

Figure 1: Relationship between artificial intelligence and its related components and technology

## 3. Main Technology of Computer Vision

### 3.1. Image Classification

The official definition of image classification is: in a given set of images, each image has been marked with the corresponding type. Then a new set of test images was predicted for their label categories and the accuracy of prediction was checked. Computer vision provides a data-driven approach. The most popular is convolutional neural network (CNN), which is also a common method in deep learning. Its network structure is usually composed of convolution layer, pooling layer and full connection layer.

### 3.2. Target Detection

Target detection methods usually output borders and markers of a single target from an image. In essence, object detection is transformed into image classification. RossGirshickyou proposed the FastR-CNN algorithm and fasterr-CNN algorithm. Greatly improve the speed and accuracy of retrieval.

### 3.3. Target Tracking

Target tracking refers to the process of tracking specific objects or multiple objects of interest in a given scene. According to the observation mode, target tracking can be divided into two types: production and discriminant. The production method mainly uses the generation model to describe the apparent features of the target, and then uses the candidate target to minimize the reconstruction error. Meanwhile, discriminant method uses training classifier to distinguish target and background.

Its performance is more stable, and it has gradually become a key research method in the field of target tracking.

### 3.4. Semantic Segmentation

At the heart of computer vision is segmentation, which divides an entire image into groups of pixels, then marks and sorts them. CNN also showed its excellent performance in this process. The typical approach is FCN. After an image is input into the FCN model, density prediction is directly obtained at the output end, that is, the category to which each pixel belongs. Thus, an end-to-end method for image semantic separation is obtained.

### 3.5. Instance Segmentation

The instance elements of various forms on the image are determined, and the instance elements are clearly divided, the boundary of each instance under the complex scene conditions is clarified, and the direct difference characteristics of the instance are determined.

## 4. Application of Computer Vision Technology

### 4.1. Application of Computer Vision Technology in Smart Home

Smart home (Home Automation) is based on the living environment of People's Daily life, the office of work, entertainment entertainment as a large platform, using integrated wiring technology, network communication technology, security protection technology, automatic control technology, audio, video, image information technology and other related equipment inheritance. Form efficient, intelligent, automated facilities or things management system, to improve home safety, accuracy, convenience, art and environmental protection.

Intelligent security detection technology. Traditional intelligent security includes infrared survey, flash or audio alarm, access control and other physical sensor devices, in the abnormal or dangerous situation when the harsh sound and accompanied by flash to indicate the occurrence of abnormal conditions. But the traditional security equipment technology level is low, intelligent degree is not high, easy to produce some problems or failures, resulting in some errors of judgment or omission of alarm and other situations. And computer vision technology can make up for the shortcomings of traditional security industry and more advanced. Intelligent video surveillance is based on a web camera with image recognition, processing and analysis functions. The intelligent video surveillance system operates 24 hours a day, and uses the target detection function to identify whether someone is staying nearby for a long time and many times. After the user leaves the premises, whether someone breaks into the environment, vandalism, theft, etc. The smart video can automatically record a dangerous situation and send a threat message to the owner via the Internet. Users can use mobile APP or computer client to check the surrounding environment at any time and anywhere.

Human health abnormal behavior detection technology. The main detection object of this technology is the user. The most common abnormal health behavior is falling. Human fall detection devices are deployed in wet and prone places such as bathrooms and kitchens to detect human behavior in real time. According to different sensing methods, existing human fall detection technologies can be divided into three categories: visual, wearable and environmental deployment. Vision-based fall detection has gradually become the mainstream method due to its high real-time performance and accuracy. Its process can be summarized as follows: First, through the camera collection of family specific scene (such as bedroom, toilet, etc.) image; Then, the characteristics of

human fall are extracted from the image information. Finally, the semantic information of the scene is recognized according to the feature vector, and the possibility of human falling is analyzed. [2]

## 4.2. Application of Computer Vision Technology in Intelligent Medical Treatment

At present, in clinical medical diagnosis, most of the human organs are obtained by medical imaging and scanning equipment, and then doctors analyze the image results and make diagnosis. However, in the process of practice, the disadvantages of the traditional medical diagnosis process are gradually exposed. For example, a large number of patients and differences between individuals lead to a long diagnosis time, resulting in reduced efficiency of treatment. Computer vision technology can be used to assist medical image processing in three parts: processing, analysis and understanding. The image processing by computer vision technology can obtain the characteristic information of medical diagnosis more accurately, shorten the diagnosis time and improve the diagnosis accuracy. Gradually it is widely used in the medical field.

Electronic medical records based on computer vision technology. Traditionally, medical personnel manually input information to register medical records in the medical system, which takes a lot of time and has a high error rate. In order to save time and workload, patients' medical records are even recorded by copying and pasting, causing great defects in the medical system. Computer vision technology can be used to establish electronic medical records of patients. When recording, patient information can be automatically filled into the system by voice and face recognition, forming standardized cases. Through computer vision technology, it can not only effectively analyze the symptoms of patients, improve the quality of patient service, but also improve the shortcomings and deficiencies of traditional information recording in the past. Electronic medical records can provide convenience for medical staff to access data through unified coding input, and can form a complete set of electronic medical records of doctors' orders, which fundamentally improves doctors' work efficiency.[3]

The application of computer vision technology in the development of medical images is mainly reflected in pathological section images.

Pathological section image. Pathological study is an important basis for the diagnosis of cancer in clinic. Most of the traditional image processing methods are manual reading. However, there are some problems such as subjective factors, low efficiency and long usage time. The application of computer vision technology overcomes the shortage of manual reading and can analyze pathological sections more quickly and accurately. For example, white blood cells have always been the main evaluation index of pathological detection, but due to the variety of nuclear types, the disease level varies from individual to individual, making manual detection difficult. For computer vision systems, white blood cells are no longer difficult to identify and analyze, and differences between cells can be determined more quickly. [4]

## 4.3. Application of Computer Vision Technology in Network Security

With the penetration of information technology into all aspects of our lives, the era of big data has arrived, and every move we make is producing data. Information security in the network world has been frequently mentioned and concerned. Because network security is not only closely related to our personal life, but also plays a pivotal role in the development of all walks of life in our modern society. We have put forward higher requirements for the use of computers and the security of the network environment.

Intelligent recognition of spam images. As a carrier and medium of information, image has the characteristics of simple transmission and fast transmission. In modern times, some criminals hide illegal information in images and induce the recipients to "scan" the contents of the pictures, taking

the opportunity to obtain the stored data inside users' mobile phones. Using computer vision visual image identification, analysis, and other functions, for every single suspicious image identification, first to see whether there is such as qr code can be scan plugin, is used to identify the preliminary scan behind the web is legal, if not rule directly code the content of the image or graffiti, hidden and output some warnings to alert users.

Smart firewall. The firewall works by filtering incoming and outgoing network traffic based on user-defined rules to ensure security. The protection mechanism in the traditional firewall is more rigid, some security programs may be filtered out because of triggering user-defined rules, and some illegal programs can also escape the user's rule check. The birth of intelligent firewall has changed this situation. It has the ability of self-identification and self-learning. After the user defines the rules, it learns and trains through hundreds of intercepts, identifies and analyzes every illegal program, updates and improves its interception model according to different illegal programs, and makes an intelligent identification interception model. Effectively block the attack of computer virus and network hacker.

## 4.4. Application of Computer Vision Technology in Armed Police Force

With the continuous advancement of the era of military intelligence, the form of war will gradually change from the original "armchair soldier" to highly information and intelligent. Armed police force, as the backbone of the security of the country, society and people, of course, also need to promote the intelligent construction of the armed police force, and strengthen the application and promotion of computer vision technology in the armed police force is also due.

When it comes to information collection, computer vision is the absolute leader. For our armed police force, with the help of image recognition and processing technology, the suspect in the monitoring picture can be locked analysis; For key patrol areas, through monitoring cameras and image processing technology, we can judge whether there are potential terrorist attack risks in the environment, identify suspicious dangerous items in the picture, and timely issue an alarm to request control.

In terms of intelligent training, the movement evaluation system for individual soldiers, developed by institutions and research teams for the 2019 National Day Parade, can correctly judge the movements of examiners, thus effectively improving the efficiency of military training.[5] Computer vision technology is brought into the daily training and assessment system of armed police officers and soldiers to capture, capture and analyze the movements of officers and soldiers, evaluate the training level quantitatively, find out the deficiencies and correct them, and effectively improve the quality and effect of training. Virtual reality (VR) technology is a computer vision interactive technology that simulates real scenes. It can be widely used in the field of actual combat simulation to restore real combat scenes to the greatest extent and improve the military training level of troops.

In terms of intelligent command, with the research on AI, AR, VR and 3D modeling technology, literature [6] provides a way to integrate the moving target in surveillance video with geographic information, map the dynamic target to vectorized map through surveillance video, and truly show the movement track of pedestrians on the vector map. Literature [7] pointed out that AR technology can be used to conduct AR real-life command, mark AR for targets in specific regions, and scale targets in corresponding regions through real-time interactive technology to obtain more information and data, which can play a positive role in armed patrol, emergency conflict command and other situations.

## 5. Summarizes

A new round of scientific and technological revolution and industrial transformation are reshaping the global economic structure, and science and technology are also developing rapidly. Artificial intelligence, as a new high-tech achievement in the new era, imitates the thinking of human brain to carry out intelligent machine operation, and effectively creates value for human beings. With the deepening of relevant research and the development of subject learning, artificial intelligence has not only developed into a technical field, but also evolved into today's multi-disciplinary comprehensive science. Artificial intelligence and computer vision technology was an important molecules, on machine equipment using computer vision technology to achieve tracking, identification, such as work highly intelligent and automation, ensure the normal conduct of each work, make full use of the artificial intelligence technology, further promote the development in the field of computer vision technology and the network. [8]

## References

*[1] Liu Zhao. Research on Computer Vision and Its Application Based on Computational Intelligence [D]. Wuhan University of Science and Technology, 2011.*

*[2] Tao Yingfan, Hu Pengfei, Yang Wenming. Computer vision technology in smart home [J]. Artificial Intelligence, 2020(5): 30-38.*

*[3] Feng Lixue. Application of computer vision in medical field [J]. Digital design (I), 2020, 9(1): 275.*

*[4] Qu Xiao, Wu Naipeng. China health industry, 2020, 17(13): 168-170. (In Chinese) DOI: 10.16659/j.cnki.1672-5654.2020.13.168.*

*[5] Liang Qiming, Zhang Yan, Yang Kaikai. Application and exploration of computer vision technology in armed police force [J]. Digital design (part 2), 2020, 9(4): 9-10.*

*[6] Zhang Xu, Hao Xiangyang, Li Jiansheng, Li Pengyue. Fusion and feasibility of dynamic target and geospatial information in surveillance video Acta geodaetica et cartographica sinica, 2019, 48(11): 1415-1423.*

*[7] Liu Yan. Application and Development of AR real Scene Command in security industry [J]. China Security, 2019(07): 63-66.*

*[8] Zhang Dawei. Application of artificial intelligence in computer vision and network field [J]. Electronic Technology and Software Engineering, 2018(11): 2.*