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Analysis of the application of artificial intelligence image processing technology——based on citespace

Ju Tai

Nanjing University of Finance and Economics; No.3, Wenyuan Road, Xianlin University Town, Qixia District, Nanjing city

2578378224@qq.com

Abstract. Image processing technology has begun to be widely used in all major fields, and the update of artificial intelligence technology has also led to the progress and development of image recognition technology, which not only contributes to scientific research purposes, but also makes people's lives more convenient. The article analyses the theoretical concepts of artificial intelligence-related technologies, the current status of the application of artificial intelligence image processing technology, and the characteristics of image processing technology, and combined with the actual situation, to explore the combination of artificial intelligence and image processing technology, so that the image processing technology can be sustained and applied to life, scientific research, industry and other fields.

Keywords: artificial intelligence, image processing, CiteSpace

1. Background

In the wave of technological innovation in recent years, the fusion of image processing technology and artificial intelligence (AI) has become a key force driving the development of many industries. Especially in the field of image recognition, this technological convergence has not only spawned new application scenarios, but also gradually changed the operation mode of traditional industries. With the rapid development of AI technology, the accuracy and efficiency of image recognition systems have been significantly improved, which has brought unprecedented changes and challenges to various industries. From medical diagnosis to the service industry, from intelligent furniture to automatic driving, image processing technology has penetrated into all levels of society with the support of AI.

1.1. Wide range of applications of image processing technology in various fields

Firstly, in the medical field, these technologies are used to improve the quality of medical images, making CT scans and X-rays more accurate, allowing doctors to more accurately diagnose conditions, such as detecting cancer and identifying cellular lesions. Secondly, in the security surveillance sector, where face recognition and behavioural analysis are primarily achieved through image recognition technologies, AI is used to enhance public safety and personal privacy by improving recognition accuracy. In the automotive industry, self-driving cars use image recognition technology to identify road signs, obstacles, pedestrians and other vehicles to achieve convenient and safe driving. In recent years, image processing technology has also been used to monitor crop growth, identify diseases and pests,

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and optimise crop irrigation and fertilisation. In the manufacturing industry, image recognition technology offers the potential for quality control, automatic detection of product defects, and improved productivity and product quality. In the entertainment and social media industries, image processing technologies are used to enhance the visual effects of digital media, such as creating filters, scene recognition, and model rendering. These applications demonstrate the wide-ranging impact of image processing in different fields, which not only improve work efficiency but also create new opportunities and challenges. As technology continues to advance, applications in these areas will continue to grow and evolve.

1.2. Artificial Intelligence Technology to Advance Image Recognition

Artificial Intelligence (AI) technologies are playing a significant role in advancing the field of image recognition. In particular, deep learning and convolutional neural networks (CNNs), a core component of AI, are able to efficiently recognise, classify and process image data by mimicking the processing of the human brain. This ability to automatically extract and learn image features dramatically improves recognition accuracy and efficiency.

Compared to traditional manual feature extraction methods, AI technology enables automatic feature extraction, learning and extracting useful features from large amounts of data, making image recognition more accurate and flexible. Increased real-time processing capabilities allow image recognition to take place in a near real-time environment, which is especially critical for applications that require immediate response, such as obstacle detection in self-driving cars.

With the development of the Internet and digital storage, more image data is available, improving the performance of AI in image recognition.

Continuous innovation and improvement is one of the characteristics of AI technology, and the accuracy and applicability of image recognition continues to improve through the introduction of more complex neural network structures, improved training algorithms, and data augmentation techniques. The adaptive and learning capabilities of AI systems mean that with the passage of time and the accumulation of data, the image recognition system is able to continuously improve its performance and better adapt to new application environments and usage requirements.

Finally, the application of AI reduces the cost and need for expertise in recognising complex images and improves accessibility, making advanced image recognition capabilities more widely available to users and organisations. Together, these factors are driving the growth and popularity of image recognition technology.

2. Purpose and significance of the study

2.1. Theoretical Concepts of Artificial Intelligence Techniques in the Field of Image Processing

In the field of image processing, the addition of Artificial Intelligence (AI) technology has formed a major shift from basic image analysis to advanced visual understanding. The basic concepts of image processing include image acquisition, the process of processing image information, i.e., the process of converting visual information into digital images to meet the needs of human visual psychology and practical applications. Feature extraction, on the other hand, focuses on extracting meaningful information from images, such as edges and textures, to lay the foundation for image recognition and classification.

With the incorporation of AI, the application of machine learning in image processing has become critical. Supervised learning trains models with labelled data for image classification and target detection, while unsupervised learning processes unlabelled datasets and is applied to image clustering and anomaly detection. Deep learning, particularly convolutional neural networks (CNNs), performs complex visual tasks by learning hierarchical features in images.

For advanced applications, computer vision goes beyond basic image processing to include object recognition, image segmentation, and scene understanding. The combination of AI enhances the possibility of achieving complex visual tasks such as face recognition and sentiment analysis.

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Augmented Reality and Virtual Reality (AR/VR) realism and the use of image processing and AI technologies to enhance or create experiences, and even advanced technologies such as 3D reconstruction and motion tracking.

However, this field also faces challenges such as data privacy and security issues, as well as the interpretability and availability of deep learning models. Ongoing technological innovations, including new research such as Neural Network Architecture Search (NAS), are driving the field forward with the aim of improving the efficiency and accuracy of image processing.

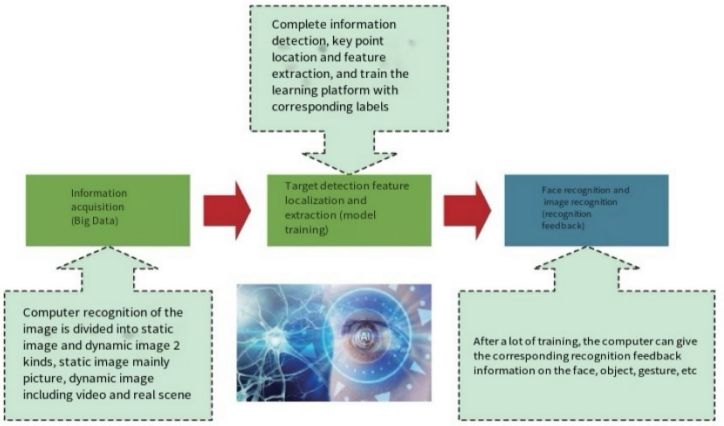

Figure1. Artificial Intelligence Techniques in the Field of Image Processing

2.2. Exploring the state of the art of AI image processing technology in a number of fields

Medical field:

There are often difficult problems in medical imaging, such as image blurring, low contrast and noise. These problems often lead to difficulties for doctors during image analysis and diagnosis.AI technology can help doctors to solve these problems and improve the quality of medical images. Among them, image segmentation is a very useful technique that can divide the image in a medical image into different regions and assign each region to a different tissue, structure or organ.

In the future, medical image diagnosis will be more personalised. ai technology can analyse each patient's image data and provide more accurate diagnosis and treatment plans based on individual patient differences. For example, based on a patient's genomic data and imaging data, AI technology can predict the risk of a patient suffering from a certain disease or provide a personalised drug treatment plan.

With the popularisation of 5G technology, the application of AI technology in medical imaging diagnosis will also become more widespread. 5G technology can achieve faster and more stable data transmission, transferring medical imaging data from the patient's site to the remote doctor's hands, which greatly improves the efficiency and quality of medical services.

2.3. Autonomous driving field

With the rapid development of deep learning, there are countless articles using deep learning to achieve image recognition. On 18 May 2016, Y. Lecun et al. published Stereo Matching by Training a Convolutional NeuralNetwork to Compare Image Patches, which for the first time proposed Using a Siamese network [1], two images, the left view and the right view, are input simultaneously, and the network is used to calculate the parallax images of the two images to control the forward direction of the vehicle. By applying the dual-channel input structure of Siamese network to deep neural network, on top of the advantages of traditional deep learning, it can also judge the distance of the surrounding objects through the difference between the two images, so as to reasonably control the car to achieve driverless.

In recent years, NVIDIA has made significant breakthroughs in driverlessness through the use of convolutional neural networks (CNNs). NVIDIA researchers have mapped raw images captured by the

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camera through CNNs into directional commands for the car, and with only a small amount of training data, the system can learn to drive automatically, even in areas with poor visibility and no lane markings, such as car parks or rugged mountain roads.

2.4. Security field

Under the development trend of artificial intelligence technology and edge computing, we have also launched the edge AI computing hardware - Intelligent Analytics Gateway, which can intelligently detect and analyse people, vehicles, objects and behaviours in the surveillance video stream, and intelligently warn of abnormal situations. Among them, the basic algorithms of V1 are human body detection, area intrusion detection, mask-wearing recognition, and helmet recognition; V2 currently has 15 algorithms, including face, human body, vehicle, license plate, behavioural analysis, pyrotechnics, intrusion, aggregation, helmet, reflective clothing, and so on, and it can also support algorithmic expansion in specific scenarios, such as bright kitchen, intelligent construction site/hazardous plant, and so on.

The application of AI in image processing is rapidly evolving and has penetrated into all aspects of our daily lives, from improving personal life experience to driving innovation in scientific research and industry. In the future, as AI technology continues to advance, it will show its amazing potential and value in more fields.

3. Literature review

3.1.1. Machine learning. Definition of Machine Learning Machine learning is the most important and popular algorithm in artificial intelligence and data mining. Some foreign scholars have defined machine learning, Mitchell believes that machine learning is the study of computer algorithms that can be automatically improved through experience; Alpaydin believes that machine learning refers to the use of data or past experience to optimise the performance standard of computer programs. Thus, machine learning is the study of algorithms that can be improved through experience or data, with the aim of using algorithms that allow machines to learn patterns from large amounts of historical data, automatically discover patterns and use them to make predictions. In other words, machine learning means that machines learn from data, and the more data they process, the more accurate their predictions will be.

3.1.2. Deep Learning. In 2006, Hinton, a professor at the University of Toronto, Canada, and a leader in machine learning, and his student Salakhutdinov published an article in Science Reducing the Dimensionalitg of Data with Neural Networks [2], which opened a new chapter in deep learning. The article suggests that this problem can be effectively solved by a "layer-by-layer pre-training" (also known as layer-by-layer initial training) approach. In this approach, each layer of the network goes through a pre-training process before entering the actual training, and this pre-training is usually done based on unsupervised learning. Such a training strategy helps each layer to learn useful features more efficiently, thus making the training of the whole network more efficient and stable.

3.1.3. Neural Networks. Artificial neural networks can be understood as a computational system that mimics the structure and function of the human brain. They are designed and constructed by humans, using directed graphs as their underlying topology. Such systems process information by responding to continuous or intermittent input signals, performing dynamic data processing tasks similar to those of the brain. In short, an artificial neural network is a computer system modelled on the human brain for complex information processing [3].

3.2. Combination of Artificial Intelligence and Image Processing Technology

3.2.1. Current Status of Related Research. Computer vision is the science of simulating biological vision, which analyses and understands the information in an image or video through computers and

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related technologies. The field incorporates several disciplines, including computer science, signal processing, applied mathematics, statistics, and neurophysiology. The goal of computer vision is to enable computers to observe and understand the world as humans do and to adapt to different environments. Currently, computer vision has achieved significant results in image recognition and face recognition, and has had a significant impact in a number of fields, including transport, healthcare, finance and business. Overall, computer vision aims to create an intelligent information system that is able to react sensitively through visual information [4].

3.2.2. Successful Cases and Application Areas. In recent years, the integration of Artificial Intelligence (AI) and image processing technology has made significant progress in several fields. In the field of medical imaging and diagnosis, deep learning algorithms have been widely used to analyse medical images such as X-rays, MRIs and CT scans, and to effectively identify and diagnose various diseases. In 2008, Google pioneered a new service that analyses user searches on its search engine in order to accurately track possible outbreaks of influenza. Today, Artificial Intelligence (AI) has evolved to the point where samples can be collected on a regular basis and, through big data analytics and deep learning techniques, these samples can be used to predict diseases such as Alzheimer's disease, cardiovascular disease, cancer, and psychiatric disorders that high-risk populations may be susceptible to. Such predictions can be effective in preventing and controlling public outbreaks and improving the effectiveness of individual health [5]. In the field of self-driving cars, these technologies are being used for environmental sensing and decision making, improving driving safety and efficiency. In 2015, Drive.ai, a startup focused on self-driving technology, became independent from Stanford University's Artificial Intelligence Lab. Most of the company's founding team members have deep experience in deep learning research. Using this expertise, Drive.ai worked to solve the technical challenges of self-driving cars through deep learning algorithms [6]. By April 2016, this company had successfully obtained a driverless car testing licence in California, marking an important advancement in the field of autonomous driving. The arts and creative industries have also benefited from AI technology, especially playing an important role in the creation of new artworks and post-production for film and television. Smartphone apps enabled advanced photo editing and augmented reality (AR) capabilities through integrated AI, enhancing the user experience. Overall, these applications not only demonstrate the prospects for widespread use of AI and image processing technologies, but also herald the unlimited possibilities for technological development.

4. Introduction to the citespace analysis tool

4.1. Main features

CiteSpace is a widely used software tool, which is mainly used to help users quickly and easily understand the cutting-edge trends and hot issues in a certain scientific field, discover the knowledge base and key literature of research, and identify the main researchers and institutions in the field. However, there is a significant difference between foreign and domestic applications of CiteSpace: foreign research focuses more on the fields of information science and life science, while domestic research focuses more on the fields of management science and high technology, especially the measurement and visualisation analysis of patent literature.

Up to now, CiteSpace has been widely used in more than 40 countries. The software is continuously updated and upgraded with new features such as text mining and visualisation mapping overlay. Its developer, Chaomei Chen, is working on theoretical and applied research in the field of information visualisation, and focuses on citation analysis and mining of turning points in science.

In the future, CiteSpace is expected to show new trends. On the technical level, there will be more integration of interfaces and functions with other related software. On the research level, there will be a shift from macro-knowledge measurement (e.g., disciplines, knowledge domains, countries, research institutions, etc.) to micro-knowledge measurement, such as analysing and evaluating individual

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scientists' research results, scholarly contributions, and impact. In terms of research areas, it will be extended to the measurement and visualisation analysis of scientific and patent literature [7].

4.2. Data interpretation and analysis

As shown in the figure, a total of 300 nodes, 282 lines, and a network density of 0.0206 are obtained through the keywords. The larger the nodes and font size indicate the higher frequency of the keywords, and the thicker the lines indicate the stronger the degree of connection between the two keywords. It is generally believed that keywords with a centrality higher than 0.1 are more important, and keywords with a longer half-life tend to reflect a more persistent content of concern in this research area. The top 20 keywords with the highest frequency in the fusion of artificial intelligence and image processing research keywords have contained all the keywords with centrality higher than 0.1, a total of 5: deep learning, machine vision, target detection, image recognition, neural networks. Analysis shows that these five important keywords are closely aligned with the phrase "the combination of artificial intelligence and image processing technology" itself, which is the basic element of the research of "the combination of artificial intelligence and image processing technology", and the earliest year can be seen, these words all appear in the 2015-2019, i.e., artificial intelligence and image processing technology. As the earliest year can be seen, these words all appear in 2015-2019, that is, the early stage of the research on the combination of artificial intelligence and image processing, and the frequency is high, so it can be determined that these five keywords are the basic research module of the combination of artificial intelligence and image processing technology.

With the State Council's Development Plan on a New Generation of Artificial Intelligence in 2017, since the clear strengthening of the combination of artificial intelligence and the real society, artificial intelligence and image processing have been the focus of research in the field, with artificial intelligence in 2017-2019 and image processing in 2015-2017 having the highest rate of prominence, which indicates that scholars have the highest degree of heat in the relevant research during that period.

5. Challenges and prospects

The integration of AI with image processing technologies faces a number of challenges, including data quality and availability, computational resource constraints, algorithmic complexity, privacy and security issues. Looking ahead, however, this field is expected to lead to the development of automation and augmented reality technologies, advance the intelligence of medical image analysis, security surveillance systems, improve the transparency of algorithms, and make significant progress in innovative application areas such as art creation and smart cities. Despite the many challenges, the convergence of AI and image processing technologies heralds a wide range of application potential and technological innovations, and is expected to lead to more innovative breakthroughs as technology continues to advance and problems are solved.

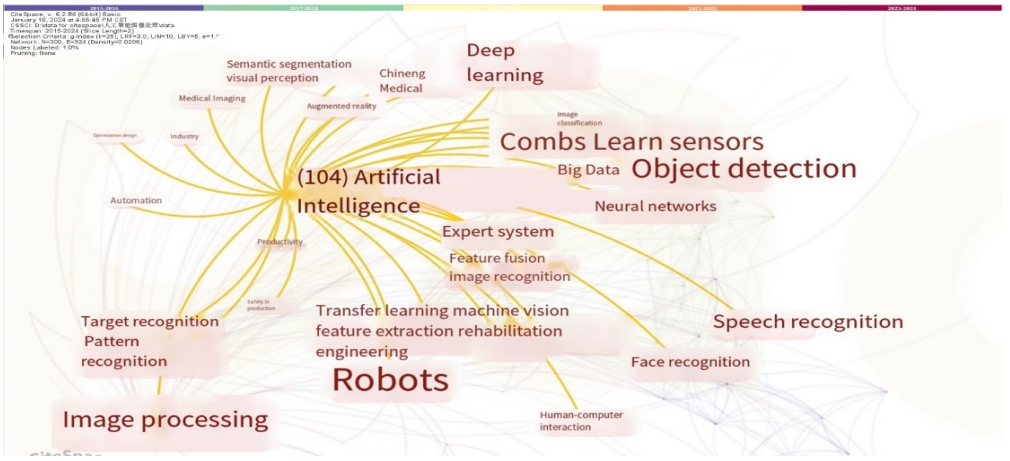

Figure 2. The image based on citespace

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5.1. Data quality and availability

In specific domains such as medical imaging, it is more difficult to obtain high-quality, high-standard data because of high costs and privacy concerns, factors that severely limit the possibility of large-scale, high-quality data collection. In addition, there is the problem of dataset bias, i.e., datasets may not be sufficiently comprehensive, which can lead to algorithms that do not perform well with certain specific groups or contexts. This is particularly evident in the case of face recognition technology, where for example, there are significant differences in the performance of the technology between different races. Thus, while the availability of high-quality data is critical to the effectiveness of algorithms, in practice it faces multiple challenges such as cost, privacy and data bias [8].

5.2. Privacy and Security

Privacy and security are two important issues in AI technology. Firstly, how to effectively use image data without violating individual privacy and remit it into a database, so it is important to ensure that personal information is secure and privacy is adequately protected when collecting and analysing image data. Secondly, adversarial attacks are also a serious security threat. This type of attack is carried out by making small, almost imperceptible to the naked eye, modifications to the image, thereby deceiving the AI model and causing the model to make incorrect judgements or behaviours. This attack not only demonstrates the vulnerability of AI systems, but also puts higher demands on the security and reliability of AI applications. Therefore, addressing privacy protection and enhancing the system's ability to counteract adversarial attacks is the off to promote the healthy development of AI technology [9].

5.3. Automation and Augmented Reality

The automation capabilities of AI significantly improve the efficiency and accuracy of image processing. In tasks such as image classification and target detection, AI algorithms are able to rapidly analyse large amounts of data to accurately identify and classify objects in an image. This not only increases processing speed, but also reduces the likelihood of human error being present, especially in scenarios where high complexity or large amounts of data need to be processed, such as medical imaging analysis, satellite image processing, etc.

Second, the integration of Augmented Reality (AR) technology brings new possibilities for user interaction experience. For example, virtual fitting rooms in the retail industry. Customers can see how clothes look on them without actually trying them on through AR technology. This not only enhances the shopping experience, but also facilitates users to make more appropriate purchasing decisions. In addition, AR can provide a richer and more interactive experience in a variety of fields such as education, gaming and design.

5.4. The field of heritage revitalisation

The outlook for the use of Artificial Intelligence (AI) and Image Processing technologies combined with Augmented Reality (AR) in the field of heritage revitalisation is extremely broad and can change the way we interact with our historical and cultural heritage. These technologies can create interactive historical experiences, such as using AR glasses to interact with historical figures in museums or explore ancient cities. In terms of heritage restoration, AI can help reconstruct damaged or lost artefacts and present them to the public in 3D through AR technology. In addition, AR and AI technologies allow people to virtually visit museums and historical sites around the world from the comfort of their own homes, which not only promotes the preservation of cultural heritage, but also enhances global cultural exchange and understanding.

6. Conclusion

In summary, the integration of artificial intelligence with image processing technology has brought about revolutionary changes and new opportunities in fields such as healthcare, security, and autonomous driving. Despite facing challenges like data quality and privacy security, the synergy between AI and image processing is expected to drive further innovation, enabling automation, enhancing augmented reality experiences, and playing a significant role in heritage preservation and revitalization as technology advances and challenges are addressed.

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