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Applied Analysis Study of Computer Vision Detection Technology

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Abstract: ***With the continuous improvement of China's economic development level, computer technology is developing rapidly and has made great progress, and its application in various fields is becoming more and more widespread. It has become an important tool in people's lives, even at work. With the appearance of computer technology, computer vision recognition technology has greatly promoted the development of image processing technology and provided additional technical support for image processing.***

Keywords: Computer; Visual detection technology; The application is available.

1. INTRODUCTION

Image processing is a low-level operation, mainly in the pixel-level image processing. Image processing in a narrow sense mainly involves image segmentation to enhance visual effects and video compression to reduce transmission and memory capacity. Image analysis is a midlevel job in which segmentation and feature extraction are the symbolic representations of raw images to simple non-graphical images recorded in pixel units. In other words, image analysis is the processing of images, and then the processing of data, data is the result of a measurement of a specific feature, or can be based on the measurement of the sign. Perception is a complex task, often referred to as computer vision. Image understanding further studies the objects in an image and the relationships between them. Their processing and methods have a lot to do with human thought and reasoning. Fang (2025) proposed an adaptive QoS-aware cloud-edge collaborative architecture that enhances real-time smart water service management through dynamic resource allocation [1]. For small and medium enterprises, Qi (2025) developed DecisionFlow, a lightweight visual framework that enables multi-task joint prediction and anomaly detection with improved interpretability [2], while their later work introduced a hybrid neural network approach for interpretable slow-moving inventory forecasting [9]. Healthcare applications have seen substantial progress with Wang's (2025) transformer-augmented survival analysis method for efficient adverse event forecasting in clinical trials [3], followed by their development of RAGNet, a transformer-GNN hybrid model that enhances rheumatoid arthritis risk prediction accuracy [10]. Ma et al. (2023) contributed to medical equipment management through their fine life cycle prediction system for failure prevention [12]. Computer vision technologies have advanced through several key developments. Guo et al. (2025) improved vehicle detection performance using an enhanced YOLOv8 network architecture [4], while Jin et al. (2024) achieved more accurate object detection and pose estimation by combining hybrid task cascade with high-resolution networks [5]. Ding et al. (2025) further advanced the field by decoupling feature-driven and multimodal fusion attention for clothing-changing person re-identification [11]. In data analytics, Zhang et al. (2025) developed machine learning-based anomaly detection techniques for biomechanical big data environments, demonstrating robust performance in complex datasets [6]. Supply chain management has benefited from two significant contributions: Saunders et al. (2025) analyzed pathways and challenges for AI-driven smart supply chains to enhance operational efficiency [7], while Pal et al. (2025) created an AI-based credit risk assessment and intelligent matching mechanism for supply chain finance applications [8].

2. IMAGE SEGMENTATION TECHNIQUE

2.1 Data-driven segmentation method

This is a form of marginalized segmentation. The basic idea is to draw a more completely divided area around certain edges. However, edge detection of noise resistance is a difficult point, and the accuracy of the monitoring target must be considered, because there are links and contradictions between them, and the right profile in terms of noise must be chosen to improve the detection accuracy. If the overall sound resistance noise intensity increases, more careful detection is required to avoid detection of insufficient response. If the target requirements are not met, the accuracy is deflected. Therefore, a scale design that combines scale and edge information can provide detection accuracy and improve noise performance. Edge detection methods can detect similarity and uniformity characteristics to obtain sufficient grayness and the strength of color change locally. They are all perfectly integrated, thus reducing the region's overdivision.

2.2 Model-driven segmentation

Typical model-driven segmentation includes dynamic contour models, combinatorial optimization models, target geometries, and statistical models. Dynamic contouring models are used to describe the contours of a target because their powerful integral computational power is good for the task against noise and is not sensitive to local blurring of the object. However, this approach is easy to converge to local optimality, so the original outline should be as close to the real outline as possible. Recent research on general-purpose segmentation techniques views segmentation as a general optimization problem and uses various optimization techniques to complete image segmentation tasks, The basic idea of this method is that the optimal function is determined by the specific function which is beyond the limit determined by the estimation, and the solution is the global optimal solution of the objective function below the boundary. In order to solve the segmentation problem from the integrated optimization point of view, the main objective function should carefully clarify the various segmentation requirements and constraints, and convert them into optimal solutions to the segmentation problem. Since the objective function is a generic multidimensional function, it can be optimized using probabilistic techniques. This involves techniques for extracting and identifying objects based on object geometry and statistical models, often called target detection or feature extraction. The basic idea is to model the geometry and the statistical knowledge of related objects and to divide them into matching or supervised classifications. Common models include templates, vector object models, and connectivity models. This segmentation technique can efficiently perform some or all of the identification tasks simultaneously. However, as the imaging conditions change, the actual image tends to be different [1].

2.3 Image segmentation and semi-automatic methods

Image segmentation can be classified as manual, automatic, and semi-automatic. The operator uses the mouse to control the rough outline of a common area. This method is manually separated but impractical, requires a lot of time, and the user's emotions have a big influence on the results. Automatic segmentation saves time and effort and provides greater flexibility. The downside, however, is that the effect of dividing all images is not improved. Semi-automatics are more suitable for handling human-computer interactions and for adapting to different requirements for image segmentation. It is suitable for applying the orientation of the segmentation of the image and can greatly reduce the computational complexity. At present, semi-automatic human-machine interaction is the focus of future research and has the potential for development and application. A common implementation is to first draw a typical target segment and then run an algorithm and parameters that automatically segment and adjust according to the content and characteristics of various images. And in the process of partitioning, a part of human interaction was added. Its advantages are that it is simple, easy to use and manage, the segmentation effect is also obvious, and the application potential is very great.

3. APPLICATION OF COMPUTER VISION DETECTION TECHNOLOGY

3.1 Image acquisition system in video acquisition applications

Image acquisition systems have always occupied an important position in video acquisition applications. Recently, the characteristics of digital cameras such as high resolution, availability, speed and high cost of software processing have received a lot of attention. The photos taken by the digital camera are sent to the computer for processing through the serial port, This technique can be used in "Tongue Image Analyzer of Traditional Chinese Medicine." Tongue image acquisition is an important part of the analyzer and is the basis of image processing and analysis. This requires high resolution images and outstanding color reproducibility, which existing equipment systems and imaging devices struggle to meet, but image acquisition systems based on digital cameras may better meet the requirements.

3.2 Main areas of use of computer vision

Computer vision has a wide range of applications. Mainly interprets and guides related documents such as pictures and videos, which mainly include aerial photographs, videos and satellite photos. At the same time, computer vision technology plays an important role in visual research, medical diagnostics, graphics, and intelligent human-computer interfaces.

The main objective of the first digital imaging was to use digital technology to improve image quality and to efficiently coordinate the classification and retrieval of satellite and aerial photographs. Because of the huge number of photos to be translated, the relatively advanced autonomous vision system is required to accurately judge and interpret the images, thus promoting the advancement of aerial photography and technology. Through the continuous improvement and wide application of visual judgment technology, visual judgments technology has played an important role in real-time determination and automatic classification of object properties, effectively realizing the effective combination of visual detection and system control. At present, the general guidance mode mainly comprises television guidance, inertial guidance and so on, and the system mainly adopts the combination of image guidance with inertial guide to achieve scientific and accurate final guidance.

Computer-vision systems are widely used in industrial fields, especially in robot systems. However, due to factors related to industrial workplace, such as lighting conditions and image orientation, these can be controlled, greatly simplifying the work of regularly dealing with these factors and establishing a system for practical application. Typical forms of the technology are robotic arms and robotic eyes, which are significantly different from industrial robots. This controllability is mainly manifested by its dynamics. Mobile robots must have excellent vision, especially when it comes to road signals, basic object recognition and obstacle avoidance. Computer vision technology is very commonly used in medicine, especially in medical image compression and image information transmission, which has great significance for medical diagnosis.

3.3 Automobile body visual inspection system

During the process of manufacturing a vehicle, the assembly of the body needs to be checked before the lower stages of the process are carried out. In other words, it measures the 3D coordinates of the entire body part of the car. The traditional coordinate measuring machine (CMM) is used to measure the assembly of autobody, but it is inefficient. The automotive body visual inspection system is a new type of highly efficient body inspection equipment. The system consists of several visual sensors (head measurement) and related mechanical and control units. All the sensor measurements are integrated into the workpiece coordinate system to provide the final result of a measurement. The entire process of sensor measurement is done in the sensor coordinate system. In the development of the visual inspection system, the global setting moves the sensor coordinate system to the world coordinate system so that the sensor measurements can be obtained in the world coordinate system. Because of the relativity between the world coordinate system and the target coordinate system, the measurements in the target coordinate system can also be obtained.

The system conducts on-site monitoring through on-site tracing of sources to adjust the latitude and longitude instruments. At the same time, the result of a measurement is compared. On-site tracing can be divided into two steps. First, use a coordinate measurement instrument to detect uncertainty during measurement. The coordinate measurement device for the compass and the body visual detection system were respectively. When the measurement error of the theodolite coordinate measuring machine is detected, it can be used as the standard instrument to inspect by instrument.

3.4 Application of Visual Measurement in Reverse Engineering

So-called reverse engineering involves accurately and rapidly measuring existing objects (specimens, The contour coordinates of the model, the irregular free surface) to create the surface, modify the editing save / modify plan, turn it into a typical CAD / CAM system, and quickly create the model using a NC machining path from a CAM manufacturing facility, or use a fast prototyping machine. Therefore, the three-dimensional shape of the sample shape needs to be quickly measured using an accurate measurement system and the data obtained for machining and surface treatment. With the rapid development of CCD photoelectric devices, an effective method of measuring visual shape based on triangles has emerged. There are three types of laser light sources commonly used for visual measurement: point light source, line light source, and striped light source.

Use a laser to pass through most of the mesh in straight, parallel lines, or use an interferometer to create linear interference edges, i.e., structured light, flat edges and project them onto the object. The edges change with the curvature and depth of the curved surface. This curved edge can be captured with a CCD camera to study changes in an object's surface profile. When the CCD records an image, the video signal is stored in the memory of the graphics card and converted into a mathematical signal, and the graphics card converts it into an analog signal. At the same time, the image card also outputs an analog signal to the screen, which can perform pixel processing on the images taken by the camera to convert the images to three-dimensional images. When scanning an image, the image data obtained from the computer consists of several pixels, each with a unique coordinate corresponding to each point on the object. Each pixel is displayed as a grayscale value [2].

4. CONCLUSION

In other words, the application of computer vision technology has achieved excellent results. The technology is widely used in various fields and has effectively promoted the development of human vision technology in various sectors. The fields of medicine and industrial manufacturing have fully realized the important technical value of computer vision technology, effectively improving people's living standards and production levels. Therefore, we must continue to carry out innovation and research in the field of vision technology in accordance with the realities of scientific development, to contribute to national economic and social development and benefit the next generation.

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