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Optimization and Performance Analysis of Intelligent Video AI Dynamic

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Abstract: In today's information age, video data, as an important carrier of information, is growing explosively in terms of production volume. The quick and accurate extraction of useful information from massive video data has become a focus of research in the field of computer vision. AI dynamic recognition technology has become one of the key technologies to address this issue due to its powerful data processing capabilities and intelligent recognition functions. Based on this, this paper first elaborates on the development of intelligent video AI dynamic recognition technology, then proposes several optimization strategies for intelligent video AI dynamic recognition technology, and finally analyzes the performance of intelligent video AI dynamic recognition technology for reference.

Keywords: Intelligent video; AI dynamic recognition; Technology optimization; Performance analysis

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1. Introduction

Recently, intelligent video AI dynamic recognition technology, a key field of artificial intelligence, has attracted increasing attention and in-depth research. This technology can automatically detect, track, and identify targets in videos, which has a significant impact on enhancing the intelligence level of video surveillance and strengthening security capabilities. However, in practical applications, intelligent video AI dynamic recognition technology still faces some difficulties, such as insufficient accuracy in recognition and relatively slow processing. Therefore, it is necessary to further optimize and analyze the performance of this technology to enhance its recognition ability and processing efficiency in complex environments.

2. Development of intelligent video AI dynamic recognition technology

Intelligent video AI dynamic recognition technology, a product intertwined with artificial intelligence and computer vision, has evolved from pattern recognition to deep learning applications, with each development stage reflecting the intelligence and hard work of numerous researchers.

In the early stages of intelligence, video recognition technology began to develop. At that time, due to the

constraints of hardware computing power, researchers mostly relied on simple image processing methods and pattern recognition techniques when analyzing static images. Although the results were limited, these efforts laid a solid foundation for subsequent development.

At the beginning of this century, with the rapid improvement of computing power and the breakthrough of machine learning theory, video recognition technology has opened a new stage of rapid development. For example, machine learning algorithms such as support vector machines (SVM) and random forests are widely used in feature classification and recognition, which greatly improves the accuracy of recognition technology.

In the early 2010s, the rise of deep learning brought revolutionary changes to intelligent video AI dynamic recognition technology. The appearance of a convolutional neural network (CNN) makes the feature extraction process increasingly automatic and intelligent, and significantly improves the adaptability and recognition accuracy of the model to the complex environment. Meanwhile, recurrent neural networks (RNN) and their variants such as Long short-term memory networks (LSTM) have demonstrated powerful dynamic feature capture capabilities in processing video sequence data [1-3].

3. Optimization strategies for intelligent video AI dynamic recognition technology

3.1. Innovative improvements at the algorithm level

The accuracy and stability of dynamic recognition of intelligent vision AI depend on innovative breakthroughs at the algorithm level, and only by integrating more sophisticated hierarchical structures and new neural network modules can it be possible to improve the adaptability of the model to objects of various sizes and shapes. For example, in the aspect of network architecture, a multi-scale feature extraction module can be introduced, which makes use of features extracted at different levels to improve the model's ability to recognize objects of different sizes. The specific method can be to use a pyramid-shaped convolution layer to extract coarse-grained and fine-grained features, and then integrate them to obtain more comprehensive information [4].

3.2. Rational allocation and optimization of computing resources

Because the complexity of AI models is increasing, the demand for computing resources is also rising, so the optimization and reasonable allocation of computing resources has become a key chain to improve the performance of intelligent video AI dynamic recognition technology. For hardware, the powerful parallel processing capability makes GPU a key support for AI computing, and using GPU to accelerate the training and reasoning process of deep learning models can significantly improve the computing speed and shorten the response time. Edge computing, as a new computing model, moves computing tasks from the central server to the edge node of the network, which is close to the source of data generation, which can not only reduce the delay of data transmission but also help reduce the pressure on the central server to a certain extent. For applications that require fast response, edge computing has obvious advantages [5,6].

3.3. Adjustment and design of system architecture

In the design and adjustment process of system architecture, it's crucial to prioritize the concept of modularity. This approach enhances system flexibility and scalability, enabling it to adapt to changing needs easily while facilitating maintenance and upgrades in subsequent stages. The specific operation involves breaking down the system into independent modules, such as video collection, feature extraction, and object identification, ensuring that each module can be optimized separately without impacting others. Additionally, in large-scale video analysis applications, data transmission often poses a challenge to system operation, leading to network congestion and processing delays. Therefore, the system needs a data caching mechanism and transmission

strategy, such as distributed storage and parallel processing technology, to reduce the burden of the server and improve the data processing speed. Further, compression algorithms can also be used to reduce the amount of data, and more efficient coding methods can be used to reduce the bandwidth required for transmission, significantly improving the speed and efficiency of data flow. At the same time, the feedback mechanism is constructed to realize the real-time self-optimization of the system, which is extremely important to maintain the optimal operating performance of the system.

3.4. Data augmentation and quality control of annotation

In order to optimize the efficiency of the model, the strategies of data enhancement and annotation quality control can be considered. Data enhancement generates more diverse training samples by transforming and expanding the original data so that the model is more adaptable to different environments and changes. In video data, a variety of enhancement techniques such as random cutting, rotation, scaling, brightness adjustment, etc., can be applied. The transformation of video frames to simulate the environment under different angles, proportions, and lighting conditions can improve the impact resistance of the model to different environments. In addition, it can also use time sequence transformation, such as random sampling of video frames, image flipping, frame difference, etc., to simulate different dynamic changes and motion situations. To a certain extent, annotation quality control is an important step to ensure the accuracy and consistency of annotation data [7-9].

3.5. Human-computer interaction and user experience optimization

In the wide application of intelligent video AI dynamic recognition technology, the optimization of human-computer interaction interface and the improvement of user experience have become important factors in determining its market competitiveness. In order to improve the user experience, it is necessary to fully consider the needs and habits of users when designing the system to ensure that the system is not only powerful but also easy to operate and understand. First, an intuitive and easy-to-use interface design enables users to quickly get started with the system when they first encounter it. Simplifying operation steps and integrating function entry can reduce the cognitive burden of users and improve operation efficiency. At the same time, clear prompt and feedback mechanisms are also essential, they can help users to understand the running status of the system in real time, to avoid unnecessary operation errors. Secondly, a stable system can ensure that users do not have frequent failures or crashes during use, thus enhancing the user's sense of trust in the system. In order to achieve this goal, it is necessary to pay attention to the quality of code and the robustness of the system in the process of system design and development to ensure that the system can quickly return to normal operation when problems occur [10].

4. Performance of intelligent video AI dynamic recognition technology

4.1. Accuracy

To ensure continuous improvement in this important dimension, scholars have explored all possibilities from multiple directions and conducted in-depth research. At the algorithm level, representatives advance the application of cutting-edge deep learning models by tuning network models and parameter settings to allow models to more accurately extract key features from images. Meanwhile, the use of big data and cloud computing provides solid support for the progress of model learning. With massive annotated data, models are capable of comprehensive learning and adapting to various complex situations and targets. Furthermore, the integration of multimodal technology allows models to comprehensively utilize diverse information such as sound and text in images, further improving recognition accuracy. In addition to optimization at the algorithm

level, researchers also optimize from the perspective of practical application to improve technology accuracy. For example, in security monitoring, when models are combined with contextual information, they can identify abnormal events more accurately; in intelligent transportation, real-time analysis of traffic flow data enables a more accurate prediction of traffic congestion [11-12].

4.2. Real-time performance

Real-time performance, which is crucial for the effectiveness of practical applications in various fields, especially in scenarios requiring immediate response such as security monitoring and smart transportation, the processing rate of technology is critical. To meet the requirements of real-time performance, researchers have carried out multidimensional optimization and attempts. First, it is necessary to optimize the architecture and parameters of algorithms. Researchers simplify network architecture and reduce computational complexity to enable models to process image data more quickly while maintaining high recognition accuracy. In addition, the application of hardware acceleration technologies has greatly improved processing speed. The application of high-performance computing devices such as GPU acceleration and dedicated processors enables models to process and analyze large amounts of data in a short period. Techniques such as stream processing and parallel computing further improve system throughput and response speed. Stream processing allows models to receive and process image stream data in real-time without waiting for the entire image file to be processed, while parallel computing allows multiple computing units to process different data segments simultaneously, significantly reducing processing time in such scenarios.

4.3. Robustness

Robustness, or the ability of detection technology to respond to complex environments and variable factors, is one of the important indicators for evaluating its performance. In practical operations, image scenarios are often affected by various factors such as changes in lighting, occlusion, and dynamic background interference, making it necessary for technology to possess strong robustness to ensure stable recognition performance in various complex environments. To improve the robustness of the technology, researchers have employed various techniques. Among them, the introduction of attention mechanisms and the fusion of multi-scale features allow models to focus more on extracting key information, making background noise and disturbance factors more ignorable. Additionally, in practical applications, the use of techniques such as anomaly detection and fault-tolerant mechanisms plays a key role. Based on real-time monitoring and judgment of recognition results, the system can timely detect and handle abnormal situations, avoiding recognition errors caused by environmental changes or target occlusion.

4.4. Scalability

With the widespread expansion of applicable scenarios and the gradual improvement of technology, the scalability of technology has become more crucial. First, modular and standardized design concepts are widely used in the expansion of technology. By dividing technology into many independent modules, each module has clear functions and interfaces, facilitating replacement and upgrading. At the same time, standardized data facts and communication protocols enable technology to connect and integrate with other systems and devices, improving the flexibility of technology and reducing the cost of expansion and maintenance. Secondly, the use of development tools such as APIs and SDKs provides developers with more convenient and flexible expansion paths, allowing developers to easily call various functions of technology to implement their own business requirements and enabling developers to customize and optimize technology according to actual needs [13-16].

4.5. Security

With the wide application of technology, more and more data and information are involved. How to ensure the security of these data and information and prevent illegal acquisition, tampering or abuse has become a problem that must be faced in the development of technology. At present, the encryption of data can ensure the security of data during transmission and storage, and prevent illegal interception and cracking. At the same time, strict permission control and authentication mechanisms need to be implemented in the process of data access and use to ensure that only authorized personnel can access and use relevant data. In addition, network security technologies such as firewalls and intrusion detection systems can monitor and defend against network attacks and intrusions in real time, ensure system stability and data integrity, and prevent attackers from taking advantage of them.

5. Conclusion

In summary, the optimization and performance analysis of intelligent video AI dynamic recognition technology not only promotes technological development in this field but also provides valuable references and insights for other related fields. It is hoped that future research can continuously break through existing limitations on the basis of ensuring the reliability and stability of technology, promote the expansion of intelligent video AI dynamic recognition technology to more extensive application scenarios, and bring more benefits to human society.

Disclosure statement

The author declares no conflict of interest.

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