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EFFECTIVENESS OF DATA PROCESSING AND TECHNICAL APPROACHES IN FACIAL RECOGNITION SYSTEMS

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Abstract
The article explores the methods for improving the efficiency of facial recognition systems through advanced data processing techniques and discusses the technical requirements these systems must meet.

Keywords: Artificial Intelligence, Deep Learning, Edge Computing, Convolutional Neural Networks (CNN), VGG, Transfer Learning, Face Recognition, Biometric.

Introduction

In recent years, facial recognition technologies have experienced significant advancements, driven by the widespread adoption of Artificial Intelligence (AI) and Deep Learning algorithms. These innovations have opened new possibilities for more accurate and reliable facial detection. However, processing large volumes of data while ensuring high accuracy often increases computational demands. As a result, optimizing algorithms and implementing technical approaches is critical for the efficiency of facial recognition systems.

The first important technical approach is the use of Convolutional Neural Networks (CNNs), which have proven highly effective in analyzing and learning facial features. Notably, the VGG network, introduced by Simonyan and Zisserman (2014), has achieved significant breakthroughs in facial recognition, demonstrating the efficiency of deep networks.

Another key technique is Transfer Learning, which adapts pre-trained models to new tasks. This method is widely employed in facial recognition due to the high computational costs associated with training large datasets. Razavian et al. (2014) showed that pre-trained models can be easily adapted to new datasets and applied to various applications.

In addition to these methods, Edge Computing significantly reduces server load by processing large datasets locally on devices. This enables real-time facial recognition by minimizing computational latency, as shown in the studies by Shi and Dargie (2016). Edge computing is particularly advantageous for mobile and IoT devices, enhancing the efficiency of facial recognition systems in distributed environments.

While the technical approaches discussed greatly improve the effectiveness of data processing in facial recognition systems, future developments must focus on optimizing resource use and introducing novel algorithms. Effective resource management is vital as these systems evolve to handle increasingly complex data in diverse real-world applications.

To ensure the efficiency of AI-based facial recognition systems, several key requirements must be met. First and foremost, accuracy and reliability are of utmost priority. The system must maintain high precision in facial identification, remaining stable against variations in lighting, facial angles, and expressions (Jain et al., 2011).

Secondly, speed is essential. The system must recognize and process faces rapidly in real-time, particularly in security and surveillance applications where delays are unacceptable (Sundararajan et al., 2018). Moreover, privacy and security concerns must be addressed, as facial data is personal and requires protection (Dwork, 2014). Lastly, scalability is crucial—facial recognition systems must perform efficiently in both large databases and real-time monitoring environments, while also adapting to diverse technologies and platforms (Parkhi et al., 2015).

Face recognition is a kind of biometric recognition technology, which usually collects human face image by camera or directly analyses data information containing human face image, and uses computer face recognition algorithm for image detection and tracking. The core technology of face recognition is the recognition algorithm. In addition, the recognition accuracy and efficiency are the general indicators to measure the algorithm. Face recognition technology is an interdisciplinary subject. It is a process of continuous integration of mathematical statistics, biotechnology and other disciplines. From the beginning of simple mathematical statistics and model processing, to the following neural network based on machine learning, and then to in-depth learning, every progress of face recognition technology has distinct stages. Characteristic. Face recognition does not require any operation of the acquisition object. It only needs to stay in front of the acquisition equipment for a moment. It can also be hidden acquisition. Compared with the passive acquisition methods such as fingerprint and iris, it is more difficult to detect, relatively more secure and reliable, and it is not easy to be forged. Face recognition needs two parts: face detection and face recognition. According to statistics, the accuracy of face recognition algorithm has reached 99.15%. Therefore, face recognition technology is recognized as one of the important technologies of information security authentication. Face detection is an effective data input, through the corresponding algorithm to determine whether there is a face, after detecting the face, according to certain biological laws and other methods to obtain evidence of the face, the obtained face features and computer reserved face features are compared, and finally the results of face recognition are obtained. The core is about the extraction of facial features from captured images, but preprocessing is also an essential step, which provides services for the process of feature extraction. The process of face recognition is shown in Figure 1.

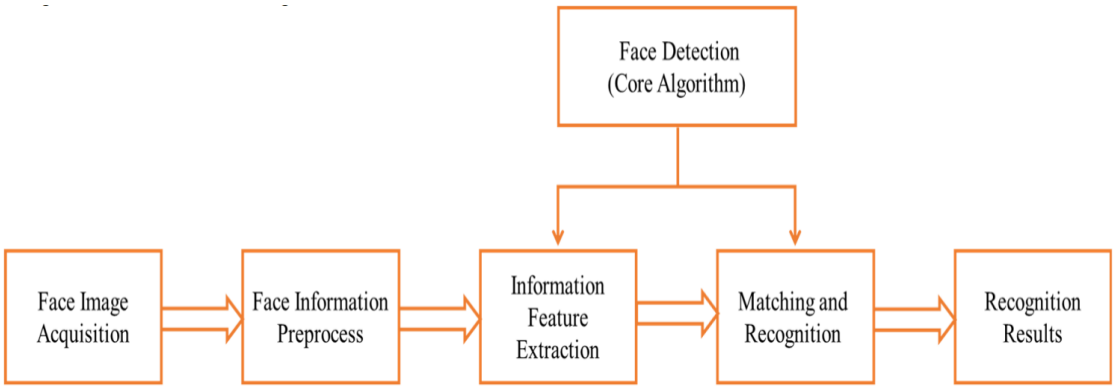

Figure 1. Process diagram of face recognition

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