

The Pattern Recognition Application Research in Image Processing

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Abstract: Digital image processing, also known as computer image processing, refers to the process of converting an image signal into a digital signal and processing it with a computer. The image is the main source of human acquisition and exchange of information. The application of image processing must involve all aspects of human life and work. With the continuous expansion of human activities, the application areas of image processing will also continue to expand. Image recognition based on pattern recognition has become the direction of image research in the field of image recognition with the development of computer and artificial intelligence technology. This paper first introduces the basic theory and basic methods of image pattern recognition, and then expounds the application of pattern recognition in image processing.

1. Introduction

Pattern recognition was born in the 1920s. With the emergence of computers and the development of artificial intelligence, pattern recognition rapidly developed into a discipline in the early 60s. The theory and method it studies have received extensive attention in many disciplines and fields, which has promoted the development of artificial intelligence systems and expanded the possibilities for computer applications. Image processing is an important field of pattern recognition methods [1]. The widely used character recognition (OCR) is a typical application of pattern recognition in image processing.

2. The basic theory of pattern recognition technology

2.1 Basic framework of pattern recognition

Pattern recognition is a sorting process by which the computer processes and discriminates information. It is an important branch of signal processing and artificial intelligence. Artificial intelligence is a discipline that specializes in using robots to imitate people's movements, feelings, and thinking processes and laws [1]. Pattern recognition is the use of computer-based mathematical techniques to study the automatic processing and interpretation of patterns. We call the environment and the object collectively the "model." With the development of computer technology and artificial intelligence, humans may study complex information processing processes [1]. An important form of information processing is the identification of the environment and the object by the living body. Of particular importance to humans is the identification of optical information (obtained by visual organs) and acoustic information (obtained by auditory organs). This is two important aspects of pattern recognition.

In image processing, identifying objects or areas in a scene is an important issue. The task of image pattern recognition is to identify objects from the scene of the set of policy objects. Each object is a pattern, and the strategy value is the feature of the pattern. The similar object set of the same feature belongs to the specific pattern class [1]. The technique of measuring the feature is called feature extraction. Image Processing Based on Pattern Recognition Technology

2.2 Pattern recognition method

Pattern recognition as an important application area of artificial intelligence has also been rapid development. Pattern recognition uses computers to classify samples according to the characteristics of the sample.

Pattern recognition methods mainly include statistical pattern recognition, structural pattern recognition, fuzzy pattern recognition, and artificial neural networks [2].

1) Statistical pattern recognition. Based on the original data information of the object to be identified, the pattern recognition is first to extract a number of corresponding feature parameters that can reflect the nature of a certain aspect of the object, and select some parameters according to the actual needs of the recognition. The combination is a feature vector. According to a similarity measure, designing a classifier that can distinguish patterns represented by the vector group can classify objects having similar feature vectors into one class.

The statistical pattern recognition process is mainly composed of four parts, including information acquisition, preprocessing, feature extraction and selection, and constructing a classifier. The classifier is a classifier design that classifies the feature vectors, and a classifier that is designed well is performed [2].

2) Structural pattern recognition. When it is necessary to accurately identify the relationship between the parts of the object to be identified, it is necessary to use the structural pattern recognition method. Structural pattern recognition is based on the structural characteristics of the recognition object, and the complex pattern structure is first decomposed into several relatively simpler and more easily distinguishable sub-patterns. If the obtained sub-horizontal pattern still has difficulty in recognition, then the pattern recognition is continued. It is decomposed until the finally obtained sub-pattern has a structure that is easily represented and easily identifiable. Through these sub-patterns, it is possible to restore the original more complicated pattern structure. These final sub-patterns are generally called pattern primitives.

3) Fuzzy pattern recognition. The fuzzy set theory holds that an element in a fuzzy set may not belong to the set with one hundred percent certainty, but may belong to the set in a certain proportion, unlike an element in the traditional set theory that either belongs to or does not belong to. The definition of this set is more in line with many ambiguous practical problems in reality, and it is more simple and reasonable to describe. Fuzzy mathematics can be used to better describe the problem of ambiguity in the reality when using the machine to simulate human intelligence, and then better deal with it. Fuzzy pattern recognition is based on fuzzy set theory. According to certain judgment requirements, a suitable membership function is established to classify the recognition objects.

It is precisely because fuzzy pattern recognition can well solve many concepts with ambiguity in reality, making it an important pattern recognition method. In the process of fuzzy membrane recognition, a recognition system similar to statistical pattern recognition is also required to be established, and the actual parameters of the identification objects need to be classified according to a certain proportion [3]. These ratios are often based on human experience as a reference value, as long as the Recognition of experience will do. After that, a classifier capable of handling ambiguity problems is established to discriminate between different categories of feature vectors.

4) Artificial neural networks. Artificial neural networks have been widely used in image segmentation and object classification problems. These networks are essentially learning networks for the classification of pixels or objects in a scene. They are a collection of interconnected neurons that perform learning tasks in parallel. Neurons are modeled by biological neurons so they are named neural networks. Depending on the type of learning process, these networks can be divided into supervised or unsupervised networks.

As one of the most important methods of pattern recognition technology, neural networks have advantages over traditional pattern recognition methods [3].

a) The neural network is a very adaptive method;

b) For any given function, the neural network can be infinitely approximated because in the whole process of classification, the neural network continuously clarifies the exact relationship based on the weight by adjusting the weights;

c) The neural network is a nonlinear model, which allows it to flexibly simulate the complex relationships between data in the real world.

3. Image Processing Based on Pattern Recognition Technology

3.1 Image segmentation based on pattern recognition technology

The technique and process of dividing an image into its characteristic regions by relevance and extracting the desired objects is called image segmentation. The key to segmentation lies in the determination of the segmentation basis. From the perspective of pattern recognition technology, the image segmentation problem is considered. Segmentation is an object that needs to be segmented according to the image [4]. According to the structural characteristics of the image, all the components of the image are divided into two categories: “split” and “non-split”. For any one thing has some essential characteristics that are different from other things, it can be extracted that the essential features can be distinguished from the segmented background image and used as the basis for identifying things. When segmenting an image positioning object, a feature space composed of features may be selected for position recognition. Therefore, the segmentation object is regarded as the object of pattern recognition [4]. The process of image segmentation is to find a specific pattern class in pattern recognition, and according to the characteristics of the pattern class, combined with its corresponding segmentation technique.

3.2 Image feature extraction based on pattern recognition technology

Due to the randomness of the image and the large amount of data, the difficulty of selecting an effective image feature in the image is increased, and the performance of the image recognition system is directly affected. Therefore, the first task to complete image recognition is to extract effective image features. However, in many practical problems, it is not easy to find the required features, or because they cannot be tested because of the conditional constraints. Therefore, the complexity of feature selection and extraction tasks becomes one of the difficult tasks in building a pattern recognition system. The original characteristics or attributes of an image are called image features. Some of them are natural features and some are human features. Feature extraction is the process of extracting features that are filtered or transformed until they yield valid features. Its fundamental task is to select effective features and apply corresponding techniques for feature extraction. The result of image feature extraction based on pattern recognition technology is to give features that distinguish a specific image from other images [5].

3.3 Image recognition based on pattern recognition

Image recognition is an advanced stage of image processing. Its research is to analyze and identify the visual images of surrounding objects through the instrument, so that effective conclusion can be obtained. However, in order for computer systems to be able to recognize images recognized by the human visual system as well, one must develop computational methods and analyze image features, so that pattern recognition techniques are applied to image recognition, and then image features can be mathematically represented and taught [5]. Computers can also recognize and identify these features.

4. Application of Digital Image Processing in Identification

4.1 Application of digital image processing in fingerprint identification

The traditional use of passwords and certificates as identification methods has the characteristics of being easily forgotten, easily cracked, easily lost, easily forged, etc. It no longer meets the needs of modern digital society. Fingerprint, as a unique physiological feature of the human body is only a small part of the human skin, but its texture complexity can provide enough features for identification, has a high degree of security, and the fingerprint is also easily accessible and non-invasive. Its uniqueness and invariability make it the focus of biometrics [3].

In order to make up for the quality defect of the fingerprint image and to ensure that the fingerprint post-processing algorithm is robust enough to the fingerprint image, image enhancement is very necessary. With digital image processing, image enhancement can be achieved. The purpose of

fingerprint image enhancement is to eliminate noise, increase contrast between ridge lines and valley lines, connect fractured ridge lines and valley lines, eliminate adhesion due to noise, deformation, etc., and improve the image due to burr caused by oil stains, etc. Quality guarantees the accuracy and reliability of feature extraction. The fingerprint image enhancement consists of image normalization, image reprocessing and filtering.

4.2 Application of digital image processing in face recognition

The development of face recognition has gone through three stages: non-automatic recognition stage, human-computer interaction stage, and automatic recognition stage. Face recognition is an important part of computer vision and pattern recognition. Face recognition can be divided into three steps: face detection, feature extraction and classification recognition. Face detection positioning is a face recognition system. The first step, which is also a key in the entire face recognition system, is one of the most thorny issues we face in researching face detection problems, such as how to quickly detect faces from an image [6].

At present, there are many methods for face recognition at home and abroad. However, according to the different face representation methods, digital image processing technology can be divided into the following three identification methods based on geometric features, based on algebraic characteristics of the identification method and based on Connection mechanism identification method.

1) A face-front image recognition method based on geometric features. The face is represented by a set of geometric feature vectors. The geometric feature vector is a feature vector based on the shape and geometric relationship of the human face organ, and is used for hierarchical recognition in pattern recognition. Classifiers are designed to achieve the goal of identification. Since this method is very sensitive to changes in facial orientation, it requires a certain degree of elasticity to eliminate the time span and the effects of lighting [6]. Geometry-based methods have small memory requirements and higher recognition speed than template-based methods. Its disadvantage is that the accurate extraction of these features is difficult to achieve. So far, this method has not been successfully applied in practice.

2) Facial frontal image recognition method based on algebraic features. Faces are represented by algebraic feature vectors. Algebraic features are extracted by performing various algebraic transformations and matrix decompositions on the grayscale of the image. This method captures the whole as a whole [6]. And to describe the characteristics of human faces, the main mathematical statistics and techniques are used, and the operations are more complicated.

3) Face-based image recognition method based on the connection mechanism. The face is directly represented by a grayscale image (two-dimensional matrix). The advantage of the neural network is its learning ability and classification ability. The advantage of this method is that the face image is preserved [6]. Material information and shape, while avoiding the more complex feature extraction work, but the common problems are low recognition rate and complex process.

4.3 Application of digital image processing in license plate recognition system

Based on the information and intelligent development trend of the traffic management system, the license plate character recognition system was proposed through the exploration of the license plate features and positioning technology. The system adopts Radon transform to correct the license plate, and analyzes the projection histogram to realize the segmentation of license plate characters. Finally, the principle of character recognition and the application method of template matching in character recognition are briefly described [7]. From the experimental results, we can see that the system can accurately achieve the positioning, correction, segmentation and recognition of license plates and has good performance.

Usually, the license plate recognition process is divided into five parts: image preprocessing, license plate positioning, license plate calibration, license plate segmentation, and license plate recognition.

1) Image preprocessing: In the entire license plate recognition system, the image quality is not high due to the fact that the image acquired is a true color image, plus the influence of the actual

acquisition environment and the acquisition hardware, etc., and the background and noise will affect the character. The correct segmentation and recognition, so before license plate segmentation and recognition processing, you need to perform image preprocessing operations on the license plate image [7].

2) License Plate Positioning: First, the morphological filtering of the license plates binary image is performed so that the license plate area forms a connected area. Then the connected area is screened according to the prior knowledge of the license plate to obtain the specific location of the license plate area.

3) License plate correction: Due to the angle problem between the camera and the car body capturing the picture, the obtained license plate picture is not horizontal [5]. In order to carry out the subsequent segmentation and recognition smoothly, it is necessary to correct the angle of the license plate. Here, Radon transform is used to correct the license plate.

4) License plate segmentation: first horizontal projection of the license plate, remove the horizontal border, and then vertical projection of the license plate [7]. Through the projection analysis of the license plate, it can be seen that the interval corresponding to the center of the maximum peak is the interval between the second character and the third character in the license plate, and corresponds to the distance from the center of the second largest peak, which is the width of the license plate character, and based on this Split the license plate.

5) Character Recognition: This paper uses template matching method to identify the license plate. In the recognition process, a standard font is first established, and the characters obtained by the segmentation are normalized, and the normalized characters are compared with the characters in the standard character library one by one. Finally, the character with the smallest error is displayed as a result [7].

5. Summary

With the development of computer and artificial intelligence technology, people pay more and more attention to the application of pattern recognition technology in image processing. At the same time, pattern recognition involves and utilizes the theoretical knowledge of mathematics, computer science and other disciplines, and the application of the new technologies and achievements of these disciplines to pattern recognition is a key issue worthy of studying in the future.

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References

- [1] Y.D. Wu, The application of digital image processing technology in image recognition, Journal of Dalian University of Technology, 2012, vol. 2, pp. 13-15.
- [2] J.L. Zhang and L. Zhao, Image segmentation based on pattern recognition theory, Science and Technology Innovation Herald, 2014, vol.4, pp.17-19.
- [3] N.N. Huang, Research on pattern classification technology in remote sensing images, Chinese Academy of Sciences, 2003, pp. 11-13.
- [4] Y.W. Fan, Research and application of digital image processing, Journal of Zhejiang University, 2013, vol. 9, pp. 16 - 18.
- [5] F.H. Lu, Application of License Plate Recognition Technology in Intelligent Transportation Systems, China Science and Technology Expo, 2010, vol.12, pp.300-302.
- [6] F.L. Qi, Pattern Recognition and Image Processing, Shanghai: Shanghai Science and Technology

Press, 2013, pp. 43-47.

[7] Ch.S. Wu, Research on Automatic License Plate Recognition Technology, Jiangxi Normal University, 2013, vol. 8, pp. 18-21.