Application of Fuzzy Recognition in Image Information Recognition

Junlian Huang 1, *, Dongyan Zhao 1, Boxue Lv 2
1 Gengdan Institute of Beijing University of Technology, Beijing 101301, China
2 Vimicro Corporation, Beijing 100000, China.

*Corresponding author email: huangjunlian@bjut.edu.cn

Abstract. Image recognition is to calculate and analyze the information contained in the image, classify it or extract useful information from it. Image recognition technology based on fuzzy recognition is a new type of image recognition technology developed with the development of modern computer technology, image processing, artificial intelligence, pattern recognition theory and so on. It is an image recognition method based on traditional image recognition methods and fusing fuzzy recognition algorithm. This paper verifies the fuzzy recognition program, reads the pixel matrix of the file, and gets a relatively clear image after certain program processing. The simulation results show that the fuzzy recognition method can get more clear and accurate information in the application process of image information technology.

Key words: Image Recognition; Pattern Recognition; Digital Image Processing.

1. Introduction

Digital image processing technology began to develop in the early 1960s, through the initial stage, the development stage, the popularization stage and the wide application stage. After decades of research and development, the theory and method of digital image processing has been further improved, and its application scope is broader. It has become a new interdisciplinary, and has entered the practical stage. In recent years, with the rapid development of computer and related fields, the rise of scientific computing visualization, multimedia technology and other research and application, digital image processing from a specialized field of discipline, into a new scientific research and human-computer interface tools, its research and application presents a new momentum of vigorous development, we can predict the digital image processing The development trend of theory is mainly reflected in the following aspects.

(1) From the end of the 20th century to the beginning of the 21st century, there are some new hot spots in the field of image processing technology: in the aspect of image security technology, it focuses on the research of image digital watermarking and image information hiding; in the aspect of automatic image recognition, the extraction and verification of human biometrics cause high attention; in the aspect of image understanding, higher-level issues such as image matching and fusion get more attention; in the aspect of image recognition, the research of image matching and fusion has attracted more and more attention; In image database, the research of content-based image and video retrieval continues to heat up.
(2) "Traditional" image segmentation and image compression coding still have research value. Image segmentation and image compression coding are the two research directions that occupy the most literature in recent ten years in China. Scholars' interest in these classic problems reflects the importance of this topic. For example, image segmentation is the key step from image processing to image analysis. Image compression coding has great application value, but also reflects that these works are quite difficult and challenging.

(3) Strengthen the further study of human visual characteristics and psychological characteristics. As an edge discipline, image processing technology should learn from other disciplines' theories, technologies and methods to improve the theory and technology system of image processing. The research on human visual mechanism and machine processing technology will effectively promote the development of image processing technology.

(4) In terms of hardware technology, we should further improve the accuracy and at the same time focus on solving the problem of processing speed. For the problem of large amount of data, parallel multiprocessor technology can be used. It is an effective way to solve the speed problem to realize the software with hardware, that is, to solidify many functions of image processing on the chip to make it more convenient for application. It is worth mentioning that computer technology has also entered an era called post PC technology. Some scholars believe that embedded intelligent tools will be the greatest invention after PC and Internet. Now embedded technology is in full swing, which has become the common development direction of communication and consumer products. In the field of communication, digital technology is replacing analog technology. In the field of radio and television, it has been applied to the transformation from analog TV to digital TV. The core technology of set top box, which has a good market prospect, is the embedded technology of 32-bit or above chip level. Embedded devices have natural human-computer interaction interface. The multimedia interface centered on GUI (graphical user interface) screen gives people great affinity. Small hand-held embedded system has achieved initial results in image technology such as handwritten text input and bar code scanning. It can be predicted that embedded system will play an important role in image and video processing.

(5) Image processing technology has a broad market prospect in the research and application of image communication. The development of image processing will focus on the development of HDTV (high definition television), the transmission of images and videos on the Internet, the retrieval of images and videos on the Internet, and the theoretical and technical research of real-time image processing.

(6) Research on new theory and technology of intelligent image information processing. In recent years, some new theories and technologies have been introduced into the field of image processing, such as wavelet analysis, fractal geometry, artificial neural network, mathematical morphology, fuzzy logic, genetic algorithm, adaptive signal processing technology, agent-based system and so on. These theories and technologies make the means of image processing more intelligent.

(7) Research on Standardization in the field of image processing. In the past 20 years, many international standards have been established for image storage and transmission, which have greatly promoted the development of image processing market. However, the establishment, retrieval and communication of image information is an important issue. It is necessary to establish image information database, unify storage format, establish standard subroutine and unify retrieval method.

2. Fuzzy Pattern Recognition

Pattern recognition is machine recognition or computer recognition, which aims to make the machine recognize objects automatically. For example, handwritten numeral recognition, character recognition, object recognition in image, license plate recognition of car running red light in intelligent traffic processing system, etc. The purpose of this subject is to make the machine have the ability to analyze, describe and judge things and phenomena, so as to complete some recognition work that human can do.

The content of pattern recognition research is to use computer to classify the objective objects, and make the recognition results consistent with the objective objects as much as possible under the condition of minimum error probability. The most basic way for a computer to distinguish things is to
The template matching algorithm, for example, is to compare the things to be analyzed by computer with the standard template, and calculate the error between the recognized objects and the standard template. For example, to recognize a handwritten numeral, it is necessary to compare it with 10 numeral templates from 0 to 9, and calculate the error with each template. Therefore, first of all, it is necessary to establish an effective measure that can give the difference of different objects, which is one of the key points of pattern recognition.

The foundation of fuzzy recognition theory is fuzzy mathematics. According to the thinking logic of human beings to identify things and the recognition characteristics of human brain, it turns the binary logic commonly used in computer to continuous logic. The result of fuzzy recognition is determined by the degree of membership of the identified object. For general recognition methods, an object can only belong to a certain category. In fuzzy mode, an object can belong to one category to some extent and another category to another extent. Therefore, it is suitable for the situation where the object itself is classified or the recognition result is required to be fuzzy.

The computer system that carries out pattern recognition is called pattern recognition system. Designers design pattern recognition system according to their needs, and the system is used to perform specific tasks of pattern classification. A typical pattern recognition system is shown in Figure 1. It consists of five parts: data acquisition, preprocessing, feature extraction, classification decision and classifier design. It is generally divided into upper and lower parts. The first part completes the classification of unknown class patterns. The second part is the training process of classifier design. Samples are used for training to determine the specific parameters of the classifier and complete the design of the classifier. The classification decision plays an important role in the process of identification, and the samples to be identified are classified.

### Figure 1. Schematic Diagram of Pattern Recognition Process

3. Realization of Fuzzy Image Recognition

In fuzzy classification, the fuzzy mean vector and the fuzzy covariance matrix of each category can not be generated directly. Just like Bayesian classification, they need to be obtained from the training sample data. However, there are differences in the selection of training samples between fuzzy classification and Bayesian classification. In Bayesian classification, each category should have training samples with high "purity" to generate various mean vectors and covariance matrices; however, fuzzy classification can be that multiple categories or even all categories share a training sample to generate statistical indicators of multiple categories. In Bayesian classification, all kinds of statistical indicators can be directly calculated by the gray value of the sample, while in fuzzy classification, the statistical indicators of each category are determined by the gray value of the sample pixel and the membership function of the sample pixel.

The "fuzziness" of fuzzy classification lies in the introduction of fuzzy mean vector and fuzzy covariance matrix in the calculation of membership function of each category, and the calculation of these two statistical parameters depends on fuzzy segmentation matrix (i.e. membership degree of
sample pixel). The fuzzy classification matrix makes each sample pixel not only belong to one class, but also belong to multiple classes. That is to say, a pixel can belong to one class and another class at the same time, but its degree of subordination is different. This degree is represented by membership degree.

The above analysis shows that the fuzziness of a pixel is fully considered when establishing membership function through samples, that is, a pixel can belong to multiple categories at the same time. However, in the application of membership function classification, the established decision function still classifies a pixel into only one category, which is also the general practice of fuzzy classification. In practical application, the decision rules can also be flexibly modified, so that a pixel can be classified into multiple categories at the same time. For example, it can be stipulated that as long as the membership degree of a pixel to a certain category is greater than or equal to 0.5, the pixel can be divided into this category, so that the classification problem of mixed pixels can be solved. In particular, it can even be stipulated that as long as the membership degree of a pixel to a certain class is not zero, it can be divided into this class. This classification method is called soft classification. Correspondingly, a pixel can only be classified into one category, which is called hard classification. The result of hard classification is only one classification image, while the result of soft classification is multiple, and its meaning is not exactly the same as that of hard classification.

The fuzzy recognizer consists of two program modules, sample learning and fuzzy recognition, and a knowledge base. In our fuzzy recognizer, the transfer function of the node is a differentiable simgofd function. The input quantity of 64 nodes in the input layer is 64 component values of the image density feature vector. The output values of the two nodes in the output layer are respectively the membership degrees of the "true image" and "false image".

4. Experimental Program and Simulation
In this paper, the fuzzy recognition function provided by MATLAB software is used to simulate the experiment. Part of the program is as follows:

```matlab
function retstr = fnntrain (dt, ld, tt, sp)
retstr=-1;
Input parameter assignment start
dt=4; ld=0.05; tt=10; sp=' datasample.txt ';
End of input parameter assignment
global recordDimension;
global sampleNumber;
global weightNumber;
global distanceThread;
global WW;
global learningDegree;
global epochsNumber;
distanceThread=dt;
learningDegree=ld;
trainTimes=tt;
A=load(sp);
[Arow Acol]=size(A);
sampleNumber=Arow;
recordDimension=Acol;
disp(sampleNumber);
WW=A(1,:);
WW=[WW [1]];
```
figure;
imshow(WW,[]);
weightNumber=1;
ePOCHSNumber=1;
for jj=2:1:sampleNumber
    TrainNN2(A(jj,:));
end
for jt=1:traintimes-1
    for jt2=1:sampleNumber
        TrainNN2(A(jj,:));
    end
end
dlmwrite('filename',WW);
figure;
imshow(WW,[]);
Figure 2 is the test image 1 obtained from the pixel matrix, and its recognition figure is shown in Figure 3.

Figure 2. Test Image 1

Figure 3. Image output results
Training subfunction

function TrainNN2(a)
    global recordDimension;
    global sampleNumber;
    global weightNumber;
    global distanceThread;
    global WW;
    global learningDegree;
    global epochsNumber;
    Ldistance=zeros(2,weightNumber);
    for j1=1:weightNumber
        Ldistance(2,j1)=j1;
    end
    Fuzzy segmentation of input and output space
    for j2=1:weightNumber
        Lx=0;
        for j3=1:recordDimension
            Lx=Lx + (a(j3) - WW(j2,j3)) .* (a(j3) - WW(j2,j3));
        end
        Ldistance(1,j2)=sqrt(Lx);
    end
    Calculating the distance of fuzzy space
    Lx1=Ldistance(1,1);
    Lx2=Ldistance(2,1);
    for j4=2:weightNumber
        if(Ldistance(1,j4)<Lx1)
            Lx1=Ldistance(1,j4);
            Lx2=Ldistance(2,j4);
        end
    end
    Modifying fuzzy rules
    if( updateW==0)
        weightNumber=weightNumber+1;
        a=[a [1]];
        WW=[WW;a];
        updateW=1;
    end
    After a series of processes such as training the sub function and modifying the fuzzy rules, a picture 4 is re selected as the test image 2, and the actual figure is shown in Figure 5.

**Figure 4.** Test image 2
Thus, when the fuzzy recognition training is completed, the output of the sample is basically the same as the expected output, that is, when the error is close to zero, the program meets the expected requirements. Of course, there are often recognition errors. According to the analysis of recognition errors, the main reasons are as follows: first, in the process of fuzzy recognition training, learning new samples tends to forget the old samples, which leads to the output results not reaching the expected results; second, some features of the pictures are similar, which leads to recognition errors; third, the image recognition operation is not completed when the error reaches the minimum, which leads to the output image and the expected value There is a discrepancy. The fourth is that the input characteristic information value is not enough, which will lead to the desired information can not be obtained.

5. Conclusion
In order to recognize the image information better and faster, we introduce the concept of fuzzy recognition, which provides a new direction for the research of image information processing technology. The simulation results show that the fuzzy recognition method used in this paper is very effective, improves the recognition accuracy, and the output image results are more clear and have more recognition ability. Fuzzy recognition algorithm can carry out a lot of operations, and it can be used in known and unknown systems. The above points make the fuzzy recognition theory more widely used in real life, which is the advantage of fuzzy recognition algorithm. However, the deficiency of this experiment is that the sampled case images are relatively few, which leads to the failure to better reflect the characteristics of fuzzy recognition. We know that fuzzy image recognition technology does not only stay in the recognition of these images, it can gather a large number of images to achieve better visual effect. This is my learning goal in the future, and it is necessary to carry out a large number of image fuzzy recognition operations the results of the experiment were improved.
Acknowledgments
This work was supported in part by the undergraduate teaching reform and innovation project in Beijing Higher Education in 2019 (Innovative practice of engineering management personnel training mode based on the demand of digital building industry).

References
[1] Yankai Xu. Development of Ultrasonic Small Flow Measuring Instrument Based on STC89C52. 2019 2nd International Conference on Safety Produce Informatization, IEEE. Chongqing, Nov. 28-30, 2019, p:394-397.
[2] Computer Engineering and Applications, 2019, 55(13)
[3] YI Na; XU Jianjun; YAN Limei; HUANG Lin; Task optimization and scheduling of distributed cyber–physical system based on improved ant colony algorithm, Future Generation Computer Systems, 2020, 109: 134-148.
[4] Yang Zhao, Jianjun Xu, Jingchun Wu. A New Method for Bad Data Identification of Oilfield Power System Based on Enhanced Gravitational Search-Fuzzy C-Means Algorithm. IEEE Transactions on Industrial Informatics,15(11), NOV. 2019: 5963-5970.
[5] Lan HongFan, Zhiyu. Image recognition of steel plate defects based on a 3D gray matrix [M]. Journal of Image and Graphics, 2019, 24(6)
[6] LI Qiuzhen, LUAN Chaoyang, WANG Shuangxi. Quality evaluation of face image based on convolutional neural network [M]. Journal of Computer Applications, 2019, 39(3)
[7] Wang Yepei, Song Mengjiao, Wang Xuan, Zhao Zhihong. Orientation analysis of judgment results based on deep learning [M]. Application Research of Computers, 2019, 36(2)