Research on artificial intelligence machine learning character recognition method based on Feature Fusion

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Abstract. In this paper, the artificial intelligence machine learning based on feature fusion is briefly introduced, and on this basis, the character recognition method based on artificial intelligence machine learning is studied from the perspective of character recognition system classifier and character recognition performance. The continuous development of artificial intelligence technology has made people more in-depth research on it. Machine learning has also become a new core research issue in artificial intelligence. It has been widely used in network search, language recognition, and machine vision. The emergence of artificial intelligence has brought great changes to people's life and production mode, coupled with the development of science and technology and network technology, people have successfully entered the information age, and information technology is indispensable in all aspects of people's life. With the progress of science and technology in the current era, artificial intelligence has developed very rapidly, and people's research on machine learning has also made a breakthrough. Learning ability is an important intelligent behavior of human beings. Human beings can adjust their own actions through learning, so as to obtain strong environmental adaptability.

Keywords: Artificial Intelligence; Machine Learning; Text Recognition

1. Introduction
In the process of the continuous progress of science and information technology, people begin to study in the field of intelligence, and machine learning is one of the key contents [1]. Nowadays, robot, network search and speech recognition in artificial intelligence have made some progress, but character recognition has not been effectively applied, so more in-depth and comprehensive research is needed [2]. Words permeate various forms and are vital to the exchange and development of economy, society, and science and technology. They are also indispensable to human life [3]. Before the artificial intelligence technology is mature, it is a very difficult task to realize the automatic recognition and input of characters [4]. Traditional text recognition methods are based on the intuitive morphological characteristics of text. Through statistical analysis of the morphological differences between text characters, a set of approximately optimal statistical parameters that can represent text differences are found to screen and recognize text. So as to achieve the purpose of computer text recognition and automatic entry and preservation [5]. Learning ability is an important intelligent behavior of human beings. Human beings can adjust their own actions through learning, so as to
obtain strong environmental adaptability [6]. Therefore, in a character recognition system, it is not enough to have a good recognition rate. The character recognition system should have the ability to relearn. Only in this way can the whole recognition system have good continuity and adaptability [7]. That is, under the condition that the application program of the character recognition system does not make any code modification, the recognition of another set of characters can be realized by providing the application program with learnable data for learning and training [8]. Whether in the field of science or in practical application, the research on the technology of text detection and recognition in natural scenes can innovate the thinking mode, break the inherent research mode, drive the development of surrounding industries, promote economic growth and produce huge economic benefits [9].

2. Analysis of Character Recognition in Artificial Intelligence Machine Learning

2.1. Overview of Artificial Intelligence Machine Learning

In the process of computer program research, in order to realize its imitation of the human brain, it is the key content of machine learning [10]. In the process of constructing knowledge, the human brain needs to summarize and summarize the relevant laws and phenomena existing in environmental data. Effective application of this phenomenon to cloud computer programs can effectively improve its task execution ability-related programs. Before artificial intelligence technology has been widely used, the automatic recognition and input of text is a very difficult problem that needs to be solved urgently [11]. The traditional character recognition method we use in our life is often based on its basic shape. We count and analyze the differences between characters, and then find a group of optimal statistical parameters that can represent the differences between characters, so as to realize the screening and recognition of characters, and then realize the recognition and automatic entry of characters [12].

Since the emergence of computer technology, people have optimized the related methods, but the final result of character recognition is not satisfactory. Character recognition has been studied for a long time, and different system schemes have been developed, and the degree of structural acquaintance is large. The main difference lies in the different algorithms of each module in the system. As for the future development direction of artificial intelligence technology, many people are concerned about whether artificial intelligence can surpass human beings and whether it will become more intelligent. With the rapid development of science and technology, efficient processing is the requirement. Traditional character recognition technology has been unable to meet the needs of modern development [13]. In fact, the computer artificial intelligence technology is the same as the related technologies of other disciplines, and it will inevitably encounter various difficulties and troubles in the process of development. However, human beings have now regarded the development of artificial intelligence as their dream and want to make greater achievements in this respect. Machine learning has been gradually applied to many industries, such as image processing and stock trading; Its promotion effect on the intelligent development of the whole information age is obvious.

2.2. Character recognition analysis

The analysis of the character recognition method in artificial intelligence machine learning must study the character recognition classifier, and the BP neural network human machine is one of many character recognition classifiers. The use of BP classifier first needs to build a neural network, and then design net1,2,3 respectively. These three numbers represent data with different characteristics. These data contain input and output layers, and also contain two hidden layers [14]. Before artificial intelligence technology has been widely used, the automatic recognition and input of characters is a very difficult but urgent problem. Character recognition is mainly divided into printed character recognition and handwritten character recognition. Handwritten character recognition is divided into online handwritten recognition and offline handwritten recognition. The classification of character recognition is shown in Figure 1.
In view of the current development of character recognition system, how to improve the recognition rate of printed characters is still a hot research topic, and how to recognize characters in the world scene will be a development direction of character recognition system. The traditional character recognition methods we use in our daily life are often based on their basic shapes, which make statistics and analysis on the differences between characters, and then find a set of optimal statistical parameters that can represent the differences between characters, so as to realize the screening and recognition of characters, and then realize the recognition and automatic entry of characters. The learning process is a complex intelligent activity closely connected with the reasoning process. Machine learning can be classified according to learning strategy, knowledge description or application field [15]. Generally speaking, the form of knowledge expression is determined by the algorithm selection of the machine learning system itself, and learners with the same structure can also be applied to different fields. After the construction of the machine learning text recognition system is completed, the corresponding text recognition application is carried out [16]. Take Chinese characters as an example. At present, the number of Chinese characters in our life and work is about 6000, and the number of commonly used Chinese characters is 2000. On this basis, when the recognition setting is carried out, at least 600 characters and numbers must be constructed, and the total number of character images is 10. All the constructed images were divided into 6 groups, each group selected one image as the test data, and the other nine images as the training data, combined with the neural network word world system. The features of the remaining images are used as test data to test the performance of the neural network and the classifier character recognition system respectively. The test results are shown in Table 1.

![Figure 1 Text recognition classification](image)

**Table 1** recognition performance of classifier

| Classifier type | Number of training sets (Group) | Accuracy% | Actual error rate% | Error self check rate% |
|-----------------|-------------------------------|-----------|-------------------|-----------------------|
| BP Neural network | 1                             | 100       | 0.0               | 0.0                   |
|                 | 2                             | 99.0      | 1.0               | 1.0                   |
|                 | 3                             | 98.3      | 1.7               | 1.7                   |
|                 | 4                             | 92.8      | 7.2               | 6.5                   |
|                 | 5                             | 86.4      | 13.6              | 13.2                  |
|                 | 6                             | 77.2      | 22.8              | 22.3                  |
| LSSVW           | 1                             | 100       | 0.0               | 0.0                   |
|                 | 2                             | 100       | 0.0               | 0.0                   |
|                 | 3                             | 99.3      | 0.7               | 0.7                   |
|                 | 4                             | 98.5      | 1.5               | 1.5                   |
|                 | 5                             | 95.6      | 4.4               | 4.2                   |
|                 | 6                             | 93.2      | 6.8               | 6.5                   |
3. Character recognition method based on machine learning

3.1. Development of character recognition methods
Since the emergence of artificial intelligence technology, it has won the favor and research enthusiasm of many scholars, and has now been deeply developed into all aspects of various applications. Machine learning is a branch of artificial intelligence. Due to its strong self-learning ability and the ability to learn and summarize large amounts of data, it has good practical application effects when used to solve complex classification or recognition problems with unclear internal patterns. Figure 2 shows the simple learning model proposed by the artificial intelligence master Simon (Simon).

Figure 2 Structure diagram of learning system

The input of the learner is provided by the environment. The learner induces and converts the environmental data into knowledge through the internal learning algorithm and updates it to the knowledge base, so that the next input of the learner can be affected by the last input. After the execution of the output result, the execution part feeds back the task completion status to the learning part until the learner completes the learning goal of the given task. In practical application, once a learner is trained, the environment, knowledge base and execution part determine the specific work content. Machine learning combines technologies from statistics and artificial intelligence to create algorithms that can be learned from empirical data and extended to solve problems in various fields such as natural language processing, financial fraud detection, terrorist threat level detection, human health diagnosis, etc. In recent years, more and more raw data are being collected from various sources such as sensors, web server logs, social media services, financial transaction records, security cameras and so on, which can potentially be used for machine learning models. The emergence of machine learning models frees researchers from the arduous task of analyzing the laws of data (data mining), and instead focuses more on how to obtain more representative features, and what learning algorithms and knowledge to choose Model, and how to determine the initial parameters and other issues. It is precisely because of this advantage that machine learning is widely used in various fields. The basic structure of the text recognition system based on the machine learning method is shown in Figure 3.

Figure 3 Basic structure of character recognition system based on machine learning

Figure 3 is a basic character recognition system in single classifier mode. The intuitive feeling of the block diagram seems to be that the more knowledge the classifier learns, the better the classification effect, but the actual situation is not the case. There is a critical point in the learning effect of the classifier in the learning process. When the critical point is exceeded, the learning efficiency decreases, that is, the phenomenon of over-fitting (over-learning) appears. It is difficult for a character recognition system in single classification mode to obtain good recognition results in large-scale data classification and recognition, which is directly related to the floor area ratio and overfitting of the classifier. On the other hand, the larger the dimension of the feature vector as the sample data, the more it can describe the information of the character image. However, as the dimension of the feature vector increases in the single classifier mode, the amount of calculation will increase...
geometrically, even leading to 'Dimensional disaster'. In order to solve this problem, based on the structure of Figure 3, a text method based on multi-feature group classification and feature group cross-voting is proposed. The structure of the scheme is shown in Figure 4.

![Figure 4: Structure of character recognition system based on machine learning](image)

3.2. Formation of professional framework system

The machine learning algorithm is divided into symbol representation and principle division, and the characteristics of transforming data into knowledge for array representation are clarified. During this period, the knowledge representation is directly related to the type and structure of classifier. For example, the distribution of weights and thresholds in the network structure of neural network. Spatial distribution feature is a description of the distribution of black pixels in the normalized two-dimensional space of character image, which can directly reflect the shape of characters. It is a commonly used character feature extraction method.

Suppose \( f(x, y) \) is a character image, \( g_i(a, b) \) is a sub-character image with grid number \( I \) in \( f(x, y) \), and \( I \), the size of sub-image is:

\[
g_i(a, b) = f((\text{mod}(i-1, k) \times k + a, \text{rem}(i-1, k) \times k + b))
\]

Where: \( \text{mod}(i, k) \) is the integer part of \( i \) divided by \( K \), and \( \text{rem}(i, k) \) is the remainder part of \( i \) divided by \( K \). In consideration of preventing the leakage of binary image information, the character image obtained in this paper is a grayscale image, and the calculation method is different from other documents. Assuming that \( \text{Sum}(i) \) is the cumulative value of the sub-character image with the grid number \( i \), then:

\[
\text{Sum}(i) = \text{Round} \left( \sum_{a=1}^{k} \sum_{b=1}^{k} \frac{255 - g_i(a, b)}{255} \right)
\]

Where \( \text{Round}() \) is calculated by rounding.

The stroke density feature method is to project the character image along the specified direction to form a stroke density histogram, from which the stroke component description data can be obtained. Suppose \( f(x, y) \) is character image (gray image), image size is \( N \times N \), \( n = 64 \), \( H(x_1) \) is stroke density curve in horizontal direction, \( V(x_2) \) is stroke density curve in vertical direction, \( f(x, y) \in [0,255] \), then:

Calculation formula of horizontal stroke density curve

\[
H(x_1) = \text{Round} \left( \sum_{y=1}^{N} \frac{255 - f(x, y)}{255} \right)
\]

Calculation formula of vertical stroke density curve

\[
H(x_2) = \text{Round} \left( \sum_{x=1}^{N} \frac{255 - f(x, y)}{255} \right)
\]

Note: \( \text{Round}() \) is calculated by rounding.

Finally, the stroke density feature vector of the character is determined as \( HV = \{H, V\} \), and the stroke density feature vector \( HV \) is 24x2bit in length, which accords with the constraint of character features.
When setting up a machine learning-based text recognition method, it is necessary to clarify the classifier construction characteristics of the machine learning itself, and the ensemble classifier can correctly analyze and classify a large number of unknown and known visual distances to ensure a machine learning-based text recognition system can be fully formed. Professional detection and reasonable setting of the learner in the system are carried out, and it is clear that the input of the learner must have a direct relationship with the corresponding system environment. The corresponding learner inductively transforms the environmental data according to the internal learning algorithm, and updates the new information formed by the conversion to the knowledge base to ensure that the next input of the learner and the previous input can form a certain connection, and the learner can ensure that the learner can complete the specified task. Form feedback on the learning part. Make the knowledge base, environment, and execution part reflect the corresponding work content. This ensures that the completeness and professionalism of the entire character recognition system is fully reflected, and the efficiency of character recognition is maximized.

4. Conclusions
In summary, in recent years, science and information technology have developed rapidly with rapid development. Human civilization has entered the information age. People are affected by information technology in all aspects of daily work and life. In all aspects of people's life, it is inseparable from it. Artificial intelligence machine has been paid attention to because of its unique characteristics in many intelligent products. It is also an indispensable key technology in the automatic driving technology, and it has significant practical significance to study it. With the continuous development of artificial intelligence technology, people study it more deeply, and machine learning has become a new research core issue in artificial intelligence, which has been widely used in network search, language recognition and machine vision. This paper analyzes the advantages and disadvantages of character recognition technology, and proposes a character recognition method based on feature fusion and machine learning. Paying attention to the enhancement and improvement of machine learning and clarifying the professional rationality of its application is a necessary condition to ensure the continuous improvement and progress of my country's character recognition level. In the field of text recognition, there are now a large number of literatures on artificial intelligence research, among which the most researched and applied learner is neural network. The current successful application of artificial intelligence machine learning in complex systems such as autonomous driving, in-depth question answering, and network search has given researchers of text recognition systems reason to believe that text recognition systems will one day be comparable to the recognition capabilities of human intelligence through continuous development.

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