Research on risk prediction method of software robot based on artificial intelligence

Research on risk prediction method of software robot based on artificial intelligence

Zelun Kang[1, *]

[1] Santa Barbara City College, 721 Cliff Drive, Santa Barbara, CA 93109-2312, USA

*Corresponding author's e-mail: zkang1@pipeline.sbcc.edu

Abstract. Aiming at the problem of software robot's recognition of life scenes, this paper studies the recognition and judgment method based on AI edge computing. Based on artificial intelligence methods and the theory of edge computing, through the analysis of the overall architecture of edge computing, the scene judgment rules and recognition algorithms are clarified. Mainly, the feature extraction and recognition part of the software robot image recognition function is arranged in the edge server, so that the judgment and recognition can be quickly realized and the system operation efficiency can be improved. The experimental verification shows that: under the same conditions, the software robot identification error of the method in this paper is lower, and the calculation time is shorter than that of other software robots, which is far superior to the traditional identification method. At the same time, by changing the comparison of data receiving methods, it can also be proved that the use of edge computing is more efficient, and the recognition problems in the work of software robots can be realized.

1. Introduction

With the rapid development of information technology, robotics has gradually become a key area of national construction. In this field, some developed countries have gradually taken the lead in the world, such as the "National Robot Program" of the United States, the "SPARC Robot Research and Development Program" of the European Union, and the "New Robot Strategy" of Japan. At the same time, the situation of cyberspace confrontation is becoming more and more severe. Network attack and defense has become the main content of cyberspace security in various countries. Robot technology plays an important role in the construction of cyberspace security. These all show that robotics plays an important role in the technological power and the network power. The continuous advancement of human science and technology has gradually transformed the role of human beings from the contributor of productive labor before the industrial revolution to the operator of mechanical operations after the industrial revolution. The development of automation and robotics has transformed the role of humans from machine operators to supervisors of production operations, so that humans and robots can collaborate and efficiently complete production tasks. With the development of information technology, people have gradually changed from supervisors of production operations to setters of production goals. After only passing the target tasks issued by the computer, the software robots in the computer automatically execute the pre-set script programs. Then control the physical robot of the entity to perform the operation [1].

With the introduction of emerging technologies such as artificial intelligence, big data, and cloud computing, robotic process automation has appeared in people's vision. Gartner, an internationally renowned information research organization, predicted in its "Top Ten Strategic Technology Trends in 2020" report that the rise of RPA is an important part of the future of human society to achieve

hyperautomation. RPA is a software-based automation technology that simulates user operations on the graphical interface of a computer system [2-4]. At the same time, RPA robots can be used as virtual labor, simulating human operation behavior, and replacing humans to perform highly repetitive and regular office processes [5]. In these office processes, RPA bots are mostly dealing with structured data in the form of spreadsheets, web forms or databases. Structured data has the characteristics of fixed fields and clear data structure [6-7]. For example, a bank account statement is generally composed of data with fixed fields such as transaction time, transaction type, transaction account, and trader's name. The RPA robot performs tasks according to the specified process sequence on structured data [8]. This process includes using a graphical interface to interact, or calling the API of the application to drive the client, and execute the script to achieve the target operation process, so as to reduce the number of people. the purpose of the workload. In related research, there are few researches on RPA robots and have certain limitations. RPA robots have low intelligence, poor scalability, and low reusability, and cannot meet the needs of process automation in complex task environments [9].

2. Software Robot Risk Prediction Model

Through the research on the edge computing architecture in the Internet of Things, cloud computing is introduced to judge the situation of robot identification, establish rules and identification algorithms, improve the ability of robot identification and supervision, and effectively achieve the purpose of being able to be applied in complex scenes.

2.1. edge computing

In the mobility layer, various IoT devices, various types of sensors, network terminals, smart vehicles, etc. are included. Because the mobile layer is close to the user, and has strong mobile storage and computing capabilities, it can be used to collect data and organize data. However, due to the limitations of battery technology, the mobile layer cannot independently complete data processing tasks with relatively complex operations. In the edge layer, there are a large number of data nodes, including a variety of network devices, such as routers, switches, network gateways, base stations, and servers. The distance between the edge layer and the user's mobile device is closer, and it is on the edge side of the network. The data from the mobile layer can be calculated and processed by the edge node. Due to the short data transmission distance, the network delay problem of data processing in the cloud can be effectively avoided, and the data processing capability is strong. For data that needs to be uploaded to the cloud for processing, the edge layer can also effectively perform data preprocessing to improve the efficiency of cloud data processing.

In the cloud layer, it mainly includes multiple servers with strong data processing capabilities and a large number of storage devices. As a result, it has extremely strong computing power and storage capacity, and is used to perform complex computing tasks and perform further calculations on the processing results on edge layer devices to obtain more accurate results.

2.2. Artificial intelligence-based neural network algorithm

In analyzing the calculation of edge computing, the artificial intelligence algorithm is integrated into it. The working principle of the neural network algorithm is to calculate and solve the information data in the work through the information transmission method of biological neurons. A three-layer neural network generally includes an input layer, an output layer and a data operation hidden layer, and its smallest unit is a neuron. Among them, the method of determining the nodes of the input layer mainly depends on the number of sample attributes in the data, and the number can be set to m; the number of nodes of the output layer depends on the encoding rules in the data labels, that is, it depends on the prediction process. The number of nodes; the most common way to determine the hidden layer nodes is to use the empirical formula to determine the number of hidden layer nodes by setting the constants in the empirical formula, as shown in formula (1):

$$m = \sqrt{n + L} + a \tag{1}$$

In formula (1), m represents the number of hidden layer nodes, n represents the number of nodes input to the input layer, L represents the label encoding rule, a represents a constant, and the value is 1-10.

The main data propagation method of the neural network algorithm is to weight the values corresponding to the neurons in the previous layer, and after the summation is processed by a certain offset, the linear data is obtained. After the linear values are processed by the activation function, the next layer of neurons can be obtained. The corresponding data of the element. After the layer-by-layer iteration of the data, the data output of the output layer is finally obtained. The calculation process is shown in formula 2 and formula 3.

$$S_j = \sum_{i=0}^{m-1} w_{ij} x_i + b_j \tag{2}$$

$$x_j = act\left(S_j\right) \tag{3}$$

In the application process of neural network, the linear output data of neurons has limited representation ability, and the calculation effect of activities often cannot effectively reflect the law of the data. Therefore, it is necessary to activate the linear output data. The ReLU activation function can make the neuron The data output has the ability of nonlinear representation, so as to fit various curves accordingly, thereby improving the generalization ability of the entire neural network. Therefore, for the robot detection algorithm, the activation function used in this paper is the ReLU activation function. The calculation process of the ReLU activation function takes the value of 0 when the input is less than 0, and the function value depends on the input value for the data whose input is greater than 0. The ReLU activation function can effectively solve the problem of gradient disappearance in the calculation process, and the calculation speed is greatly improved. Therefore, it is widely used in the calculation process of neural network. The ReLU activation function expression is:

$$f\left(x\right) = \max\left(0, x\right) \tag{4}$$

For robot detection in field operations, the YOLO v3 network used in this paper selects a Darknet-53 suitable for extracting image features as the backbone network. The overall calculation process is based on the structure of the ResNet residual network, so that the calculation process will not The gradient disappears or the gradient explodes, and more convolutional layers can be superimposed in the calculation process to ensure the depth level of information. For complex on-site environments, background information usually occupies a large amount of image space, and the image will be more eye-catching. Therefore, an attention mechanism can be introduced in the calculation process to improve the recognition accuracy and efficiency. At the same time, the CBAM algorithm is also known as the attention model of the convolution algorithm. This model can effectively extract the attention points in the feature layer by integrating the spatial and channel attention mechanisms. In addition, the computational workload of this module is small, and it can be integrated in various backbone networks, effectively improving the recognition accuracy of the algorithm without affecting the recognition speed. Therefore, the YOLO v3 network can be organically combined with the CBAM attention algorithm. By adding an attention mechanism to the front of the output layer of each backbone network, the feature layer of the image can obtain higher attention for the position of the focal area, effectively Improve the ability to obtain details. By increasing the weight of the object, the information recognition accuracy of the position can be further improved, and the recognition ability of the robot can be improved. On this basis, in order to improve the effect of the attention algorithm and better obtain the spatial characteristics of the algorithm, this paper adopts a 7x7 convolution kernel as the filter of the attention mechanism. The feature layer representation of CBAM is:

$$\begin{aligned} \mathrm{M}_{\mathrm{c}}(F) &= \sigma\left(MLP\left(AvgPool(F)\right) + MLP\left(MaxPool(F)\right)\right) \\ &= \sigma\left(W_1\left(W_0\left(\mathrm{F}^{\mathrm{c}}_{\mathrm{avg}}\right)\right) + W_1\left(W_0\left(\mathrm{F}^{\mathrm{c}}_{max}\right)\right)\right) \end{aligned} \tag{5}$$

$$W_0 \in \mathrm{R}^{C/r \times C} \quad W_1 \in \mathrm{R}^{C \times C/r}$$

$$M_s(F) = \sigma\left(f^{7\times7}\left(\left[AvgPool(F); MaxPool(F)\right]\right)\right) = \sigma\left(f^{7\times7}\left(\left[F^s_{arg}; F^s_{max}\right]\right)\right) \quad (6)$$

In formula (5), the MLP function is the fully connected layer, the AvgPool function is global average pooling, the meaning of MaxPool is global maximum pooling, F is the feature layer input of the function, σ is the activation function, and r is the reduction in operation rate, the value here is 0.5. In formula (6), the meanings of F_{avgs} and F_{maxs} are the channel features of global average pooling and global maximum pooling, respectively, and the f^{7x7} function represents the convolution calculation with a convolution kernel size of 7x7.

3. Experiment analysis

The test data were input into the traditional robot and the robot proposed in this study respectively to identify risk situations. The results of the test experiments are shown in Table 1.

Table 1. Identification result.

Enter the number of data	traditional error rate	Error rate of this paper	Traditional time	Time of this article
100	5.81%	1.92%	5.62	1.32
200	6.92%	2.91%	5.31	1.45
300	9.82%	4.03%	5.82	1.53
400	10.94%	4.74%	6.84	1.64
500	12.5%4	4.92%	7.45	1.72
600	13.62%	5.14%	8.63	1.84
700	14.51%	5.82%	9.22	1.95
800	17.21%	5.42%	9.13	1.93
900	18.87%	5.41%	9.82	2.02
1000	19.73%	5.69%	10.94	2.15

The results show that the method in this paper is far superior to the traditional robot risk identification method in terms of recognition accuracy and time. The identification situation after adding interference can more effectively reflect the identification method of edge computing, which can be applied to construction sites with strong interference and poor working environment.

4. conclusion

In this paper, aiming at the judgment and identification of software robots in complex environments, the identification and judgment method based on artificial intelligence is studied. The main conclusions are as follows:

(1) Using the edge cloud computing method combined with artificial intelligence, combined with deep learning algorithms, and by constructing relevant models, the identification of risk problems is effectively realized.

(2) By analyzing the comparison of risk identification results between the robot in this paper and the traditional robot, it is proved that the algorithm in this paper has the advantages of low identification error and high computational efficiency.

References

[1] Cheng Ping, Mao Junli. Research on Audit Sampling Software Robot Based on RPA [J]. Finance and Accounting Monthly, 2021(21):100-106.DOI:10.19641/j.cnki.42-1290/f.2021.21.013.

[2] Zhang Xu. Design and implementation of software robot system for typical applications [D]. Harbin Institute of Technology, 2021.

[3] He Weiling. The application of software robots in the medical expense reimbursement process of enterprises [J]. Electronic Technology and Software Engineering, 2019(24):58-59.
[4] Ge Shuzhi. Innovative practice of intelligent robots in the construction industry [J]. Software and Integrated Circuits, 2019(12):48-49.DOI:10.19609/j.cnki.cn10-1339/tn.2019.12.015.
[5] Shao Jinwei, Li Wenjie, Mo Chuming. Research on intelligent business expansion service monitoring based on software robots [J]. Electronic Testing, 2019(22):125-126.DOI:10.16520/j.cnki.1000-8519.2019.22.056 .
[6] Wang Feiyue. The future development of robots: from industrial automation to knowledge automation [J]. Science and Technology Herald, 2015, 33(21): 39-44.
[7] Wang Zhen. Design and implementation of motion control and simulation software for industrial robot controllers [D]. Southeast University, 2015.
[8] Liu Jiangping. Design and implementation of COM-based robot reconfigurable software platform [D]. Huazhong University of Science and Technology, 2014.
[9] Yu Chunlan, Wang Li. Application of software robot technology in system development [J]. Manufacturing Automation, 2003(08):55-56+60.