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Point-by-point feature extraction of artificial intelligence images based on the Internet of Things

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ABSTRACT

In the context of the rapid development of artificial intelligence in the Internet of Things, the establishment of the Internet of Things can promote rapid progress in the field of artificial intelligence. Traditional image detection methods use wavelet energy algorithms to divide background and edge noise, with poor resolution and low image detection accuracy. A series of problems such as slow detection speed and lack of image depth analysis exists. Aiming at the disadvantages of traditional methods, this study proposes the design of an artificial intelligence image detection system based on the Internet of Things, and uses intelligent artificial pixel feature collection technology to extract point-by-point feature of the image. This paper introducing artificial intelligence learning algorithms to the wheel detection in the workshop under the Internet of Things system, which can not only solve the problem of poor feature anti-interference and poor robustness in the traditional method, but also has important significance for the secondary development of the wheel detection system. The neural network can be used to classify wheel images while integrating other detection requirements, such as wheel defect detection and wheel number identification. The rich data resources and processing capabilities of the Internet of Things to perform feature analysis and feedback on the collected image pixels are utilized. The artificial intelligence of image synthesis module performs image conversion processing on the signal processes the feedback signal. The analysis results can complete image detection and complete artificial intelligence images. Through simulation experiments, it is proved that the design of artificial intelligence image detection system based on the Internet of Things has the advantages of high image detection rate, high recognition accuracy, stable operation, and efficient processing. The design idea has good application value.

1. Introduction

The rapid development of computer and internet technologies has closely linked people, machines, and the internet to form an IoT network with a wealth of data resources and a huge amount of interaction [1,2]. The establishment of the IoT network proves that Internet technology has reached the ability to support cutting-edge technology research and development, such as artificial intelligence. In recent years, artificial intelligence technology has made great progress. Artificial intelligence technology is quietly entering public life, such as drones, medicine, biosecurity and other fields [3]. In many fields, as a special form of data information expression, how to interpret the contained information has been a research problem in the field of image detection. Traditional image detection systems use algorithms such as wavelet to implement image content information detection and detection by dividing the image area and background, and analyzing image noise. This method has a series of problems such as high image clarity requirements, low pixel image recognition and detection accuracy, low accuracy, and poor analysis and processing capabilities [4]. Aiming at the problems existing in the traditional image detection system, based on the Internet of Things and artificial intelligence technology, the design of an artificial intelligence image detection system based on the Internet of Things is proposed. The intelligent artificial pixel feature collection technology extracts point-by-point features of the detected image source and converts them into digital signals to the cloud. It is to use the Internet of Things to enrich data volume resources and processing capabilities, and collect the image pixels of digital signal [5]. The information data is subjected to feature analysis and feedback, and the feedback signal passes through the artificial intelligence signal image synthesis module to perform image conversion processing on the feedback signal and output the analysis result to complete image detection. The current popular Internet of Things technology to achieve organic integration with artificial intelligence technology, a special artificial intelligence image detection system based on the Internet of Things has been proposed [6]. The characteristic of this system is that it uses artificial pixel feature collection technology, combines

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traditional image content with point-by-point feature extraction based on the detected image source, and finally converts it to digital signals and uploads it to cloud storage. The process uses many IoT database content and digital processing and computing capabilities of the Internet of Things system. For example, in the current monitoring system, a target detection and tracking technology are proposed in combination with an artificial intelligence image detection system. This technology combines artificial intelligence technology and three-dimensional vision sensor technology, which can achieve more than 300,000 three-dimensional point coordinates. It needs to construct relatively realistic three-dimensional scenes, analyze human actions in relatively complex scenes with computer understanding, and implement effective detection and dynamic automatic tracking of human targets. For example, in the monitoring process of certain traffic monitoring key areas, it also introduced abnormal behavior analysis technology, combined with the depth 3D information of the target vehicle (target height, target behavior, target position) to meet the multi-target synchronous detection technology requirements [7,8]. It is to detect the distance, depth, and distance of the target to achieve cross-border detection, and select an alarm time to change the traditional passive monitoring to active monitoring. Crowd intelligence analysis technology is also a strong point of artificial intelligence image detection system [9]. It combines the analysis of large-scale crowd gathering status, observes the abnormal behavior status of any crowd at any time, and performs high-precision statistics on the number of people in the scene. The crowd analysis system is also adopted here to cultivate and combine crowd density output and safety index optimization to comprehensively monitor and describe the abnormal state of the crowd, effectively predict the crowd activities, and provide users with accurate information in advance to help users perform various tasks.

When designing an artificial intelligence image detection system based on the Internet of Things technology, it took full advantage of the massive data resources and powerful information processing and computing capabilities inside the Internet of Things, so that the system can obtain comprehensive analysis and analysis of cloud images [10,11]. The cloud image processing and analysis module, as a transfer station between the Internet of Things and terminal data, needs to have the following two functions: the function of transferring data information and the function of accessing the resources of the Internet of Things. When setting up the cloud, the first thing we need to consider is to ensure that the special feature information collected by the system terminal has sufficient storage space and can be obtained by us at any time, and compared with the information resources inside the Internet of Things. The cloud serves as a connection medium between terminal data and the Internet of Things. If no information resources within the Internet of Things can be accessed, then it is possible to limit the system's ability to retrieve the Internet of Things data information and upload image data information for comparative analysis [12–14]. Therefore, calling the Internet of Things function is still one of the core functions of the cloud image processing and analysis module. The feature acquisition module (i.e. feature acquisition module) refers to the cloud platform image-processing module in the artificial intelligence image detection system based on the Internet of Things. This image acquisition module uses intelligent artificial pixel-feature acquisition technology. It can collect the image features of the selected area in a targeted manner, and use the image source features as the key analysis and collection objects [15]. In this way, the disadvantages of the traditional image acquisition module that need to produce the entire image to achieve information collection are effectively avoided, which provides a favorable guarantee for the enhancement of image resolution and utilization value. The image information is mainly composed of a large number of data loading points, and there is a certain difference between the data information of each loading point [16]. Therefore, the different rendering points have different imaging factors, and the imaging factors will be different. Pixels are formed according to the sorting method. Therefore, a pixel refers to a collection of image data. Therefore, we can collect information such as the outline, color difference, and contrast of the image according to the arrangement effect of the data information in the imaged collection [17,18]. The artificial intelligence image detection system based on the Internet of Things technology mainly uses intelligent artificial pixel feature collection technology and the feature capture algorithm to achieve image information collection.

In this study, the intelligent manual learning code is added to the code, so that the system's feature collection module also has the ability of feature cumulative analysis, which effectively improves the accuracy and sensitivity of the system's collected image information. In addition, the system also established a data interaction protocol between the image information acquisition module and the cloud image processing and analysis module, which established a reliable channel for the real-time upload of image data information and speeded up the system's upload of image information. The artificial intelligence signal image synthesis module is a data result output module based on the artificial intelligence image detection system of the Internet of Things. The main function of the artificial intelligence signal image synthesis module is to process the decentralized Internet of Things analysis and feedback results of the cloud architecture platform to perform image encoding processing, to realize the functions of image restoration and interpretation of image data information. The artificial intelligence signal image synthesis module is composed of a data signal input channel and an image conversion channel, and uses artificial intelligence technology to build a data interaction platform between the two channels. The data in both channels are unidirectional data interaction channels, that is, unidirectional conversion between digital signals and image signals. At the same time, the system also uses the technology of bundling artificial intelligence image synthesis module with front-end windowing code, which effectively enhances the code's flexibility, learning ability, and computing ability. The simulation experiment test proves that the design of the artificial intelligence image detection system based on the Internet of Things has the advantages of multi-resolution support, high detection recognition rate, high detection accuracy, convenience and easy to use, etc., and meets the requirements of image detection.

The structure of this study is as follows: In the second section of this study, the design of artificial intelligence image detection system will be introduced in detail, including the cloud image processing and analysis module, image feature acquisition module and artificial intelligence signal image synthesis module. In the third section of this study, system signal results and image pre-processing based on the convolutional neural network will be conducted to verify the system design. Finally, conclusions are given.

2. Design of artificial intelligence image detection system based on Internet of Things

The structure diagram of the system is shown in Fig. 1. The classification process of the wheel intelligent classification system is:

(1) The hub is transmitted through the production line. When the hub reaches the system area, the photoelectric sensor automatically detects the hub. The PLC control module receives the hub arrival signal and transmits the shooting instruction signal to the camera.

(2) The camera acquires a clear and complete image of the wheel by cooperating with the lens and light source.

(3) The camera sends the collected images to the software system through the Internet of Things system.

(4) Software system uses a database to collect and manage images

(5) The classification algorithm in the software system detects the image to obtain the classification result of the image.

(6) Finally, the software system sorts and saves the classification results and sends the relevant signals to the PLC control module. Wheels enter the next workflow of the production line.

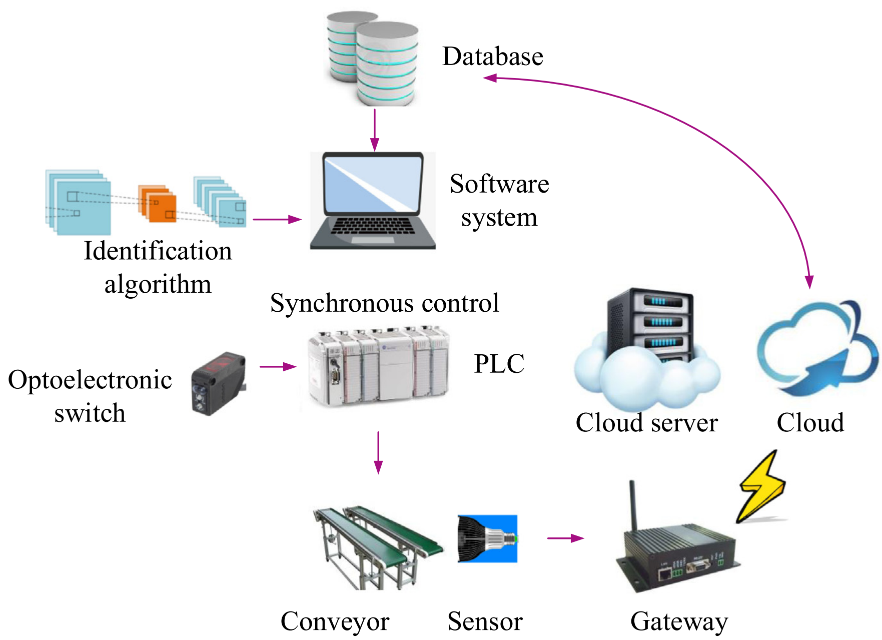

Fig. 1. System structure diagram.

2.1. Cloud image processing and analysis module

The design of the artificial intelligence image detection system based on the Internet of Things needs to rely on the rich data resources and interactive resources in the Internet space. At the same time, image information is analyzed and processed using the powerful information processing and computing capabilities of IoT. Therefore, in the design, the data transfer station of the Internet of Things and the terminal first need to build a cloud image processing module. The cloud image-processing module has two functions:

(1) The function of information transfer: the primary function of setting up in the cloud is to ensure that the image feature information collected by the design system terminal can be stored everywhere and can be compared with the information resources in the Internet of Things at any time.

(2) The function of resource acquisition of the Internet of Things: the cloud, as a bridge and medium connected to the Internet of Things space, has its own characteristics of accessing the information and data resources required by the Internet of Things.

Satisfying the above two important characteristics, the establishment of the cloud means success. In the design, the cloud erection adopts the intelligent data architecture method for erection. The intelligent data architecture method has the advantages of strong data dynamic processing ability, high degree of integration with information resources of the Internet of Things, and fast data interaction. The algorithm used in the intelligent data architecture method is dynamic, and the relationship is as follows:

$$a\Psi, b\Psi, c\Psi \Leftrightarrow \iiint a' \to \iiint b' \to \iiint c' \tag{1}$$

$$a'\Psi, b'\Psi, c'\Psi \Leftrightarrow \iiint a \to \iiint c_{\Psi} \tag{2}$$

$$|a, b, c|\, \Psi^{i=1} \Leftrightarrow \iiint (a', b', c')^{\Psi} \tag{3}$$

where a, b, c, a', b', c' are all dynamic points of the cloud architecture; i is the spatial dimension of the architecture, Ψ means the system. The i is dynamically changed and the amount of cloud data interaction is affected by its value. The cloud architecture algorithm is written and constructed using ALTER Syntax 3, which has the characteristics of stable architecture, concise language, and low maintenance cost. The pseudo-code of the architecture is as follows:

```
CREATE TABLE Persons
PRIMARY KEY (P—Id)
CREATE TABLE Persons
SELECT ProductName. UnitPrice
FROM Products
/P—Id int PRIMARY KEY AUTOINCREMENT,
LastName varchar(255)NOT NULL.
WHERE UnitPrice>(SELECT AVG(UnitPrice)FROM Products)
City varchar(255)
*FirstName varchar(255),
REATE VIEW[Products Above Average Price']AS
```

The code contains algorithm equations and various data parameters in the cloud, as well as data information such as permission codes required for data interaction with the Internet of Things. The cloud image processing and analysis module workflow are shown in Fig. 2. The cloud space building code contains the data interaction channel creation and execution code. The cloud will establish the terminal and the Internet of Things spatial data interaction channel by itself. The resource comparison of the image feature data of the Internet of Things is completed with the comparison the collected image feature data.

2.2. Image feature acquisition module

In the final analysis, the construction of the cloud platform image processing module in the design of the artificial intelligence image detection system based on the Internet of Things is to serve the image feature acquisition module in the system. The difference between the image feature acquisition module and the image information acquisition module in the traditional image detection system is that the image feature acquisition module uses an intelligent artificial pixel feature acquisition technology. A feature collection is performed for the feature area of the image, and the analysis focuses on collecting the feature composition data of the image source [19]. The data structure is optimized through the collection of image features to solve the problems of erroneous data sources, low utilization rates and low resolution of image sources caused by traditional image information uploads. The image information is composed of several data load points, and each load point has different imaging factors due to different data information. The imaging factors are arranged in a certain arrangement order to form pixels. The imaged points (pixels) formed by the data

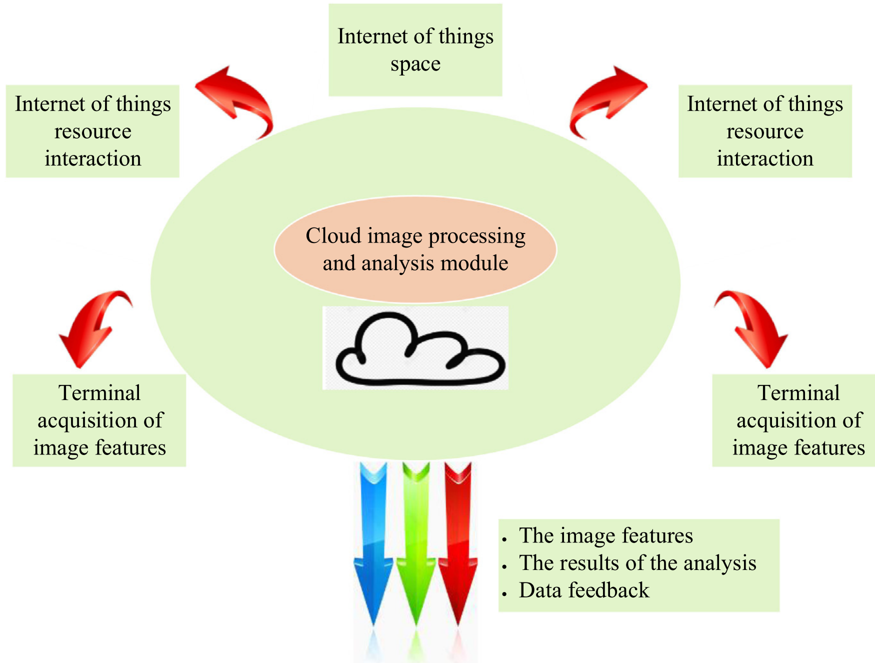

Fig. 2. Workflow of cloud image processing and analysis module.

feature information in the imaged collection will show a different arrangement effect from other pixels, making the image stand out, such as the visual effects of image contours such as houses, mountains, and rivers, color differences, and contrast. All are based on the results of the imaged arrangement of the characteristic data. Intelligent artificial pixel feature collection technology uses the Teppler feature capture algorithm to capture image feature data. The relationship between the Teppler feature capture algorithm is as follows:

$$T = \prod_{n}^{i=n} d \sum_{i} \left[\frac{\sqrt{2p-d}}{\iint n} \right] \to \cap_i \ space \tag{4}$$

The difference between the Teppler feature capture algorithm and the traditional image information acquisition curve is shown in Fig. 3. It can be seen from the comparison of Fig. 2(a) and (b) that the Teppler feature capture algorithm captures the image feature point data stably, the feature point continuity is good, and the feature difference is small. It shows that the algorithm can accurately analyze the depth of image pixels, and it shows the characteristics of artificial intelligence. The image feature acquisition module code design is written into the core program file of the program, which facilitates the front-end retrieval of the program. The pseudo-code looks like this:

```
CREATE VIEW [Current Product List] AS
FROM Products
SELECT ProductlD, ProductName, Category
ELECT/FROM ProductsfaIe
WHERE Discontinued = No
SELECT
FROM Products
SELECT
* FROM Products
```

The intelligent artificial learning code is added to the code, so that the feature collection module has the feature accumulation analysis capability and improves the accuracy of image feature data collection. At the same time, the acquisition module and the cloud image processing and analysis module have established a low-level data interaction protocol to upload image feature acquisition data in real-time and exchange data resources. So far, the design of the image feature acquisition module is completed.

2.3. Artificial intelligence signal image synthesis module

The artificial intelligence signal image synthesis module is a data result output module based on the artificial intelligence image detection system of the Internet of Things. The artificial intelligence signal image synthesis module converts the digital signal of the Internet of Things analysis and processing result of the cloud architecture platform to the digital signal for image encoding and conversion processing, restores the original appearance of the image, and interprets the data information of the image to achieve the purpose of image detection. The artificial intelligence signal image synthesis module design is divided into two channels, a digital signal input channel and an image conversion channel [20]. Data exchange between the two channels through artificial intelligence conversion. The data in the channel is a unidirectional data interaction channel, that is, a unidirectional conversion from a digital signal to an image signal. After the conversion result of the artificial intelligence is obtained, the threshold value of the image feature information data in the digital signal is set to α, and the signal conversion accuracy can be calculated and verified under specific conditions. That is, if the β value coefficient is greater than the mouth value coefficient α, it means that the characteristic data in the digital signal is arranged stably, and the image coding conversion accuracy is high. Otherwise, if the value coefficient is less than or equal to the mouth value coefficient, it means that the digital signal carries the arrangement of feature data constitutes instability, and the image conversion processing algorithm will dynamically retrieve cloud IoT data resources, leverage the advantages of artificial intelligence technology, and adjust the conversion parameters. The artificial intelligence signal image synthesis module code is bundled and written with the front-end windowing code. It has the characteristics of light and flexible code, strong learning, and high algorithm execution rate. The specific code is as follows:

```
ALTER TABLE table
[CONSTRAINT constraint_name]
COLUMN column} [⋯. n]
[NULL NOTNULL]
[ON UPDATE {CASCADE NO ACTION)]
(CHECK NOCHECK) CONSTRAINT.
```

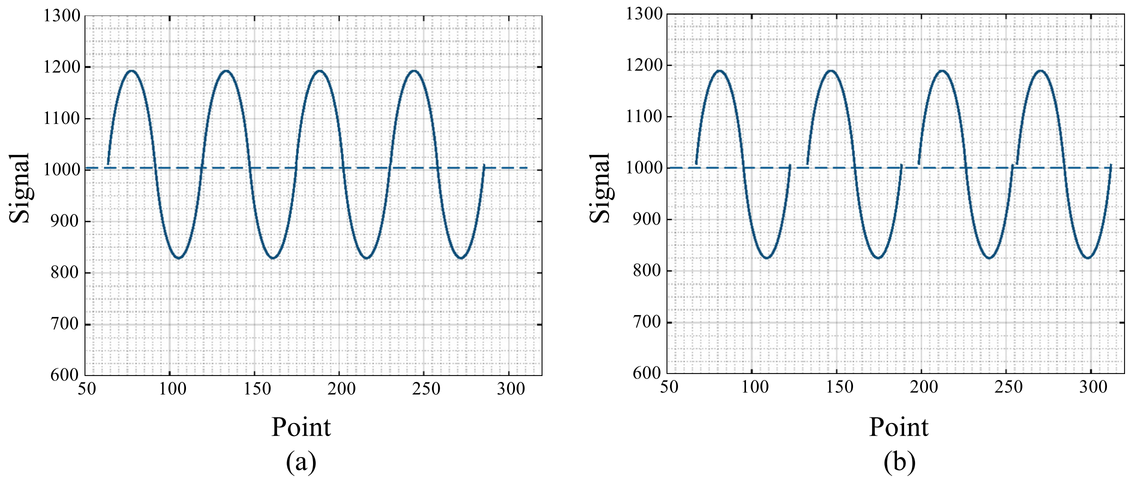

Fig. 3. Comparison of (a) the Teppler feature capture algorithm, and (b) traditional algorithm with intermittent signal.

Table 1
Parameter setting for comparison.

Items	Traditional system	IoT-based system
Distortion image detection	/	Support
Low resolution image detection	/	Support
Image detection speed	300 s	30 s
Image detection accuracy	87%	100%
CPU utilization	30%	5%
Memory utilization	30%	10%

3. Experimental result and analysis

3.1. Analysis of system stability

The simulation test of the artificial intelligence image detection system based on the Internet of Things is designed and compared with the traditional image detection system. The test platform computer is configured as: CPU 6200M main frequency 3.4 Hz, memory DDR3 1600 4G, system windows 7 64 bit flagship version. The specific test parameters are shown in Table 1. It can be seen from the comparison data that the design of the image detection system based on Internet of things performs well in image detection and testing. It has the feature of detecting image resolution, which fully reflects the advantage of artificial intelligence technology. At the same time, it runs fast and has high identification accuracy, giving play to the advantages of big data integration and analysis of the Internet of things. The system design resource cost is small, which can be used for the arbitrary configuration of computer platform. The stability of the image detection system based on the Internet of things was tested for 180 days. The test curves are shown in Fig. 4. According to the stability curves, it can be proved that the image detection system based on the Internet of things has good stability performance and practicability, which meets the design requirements.

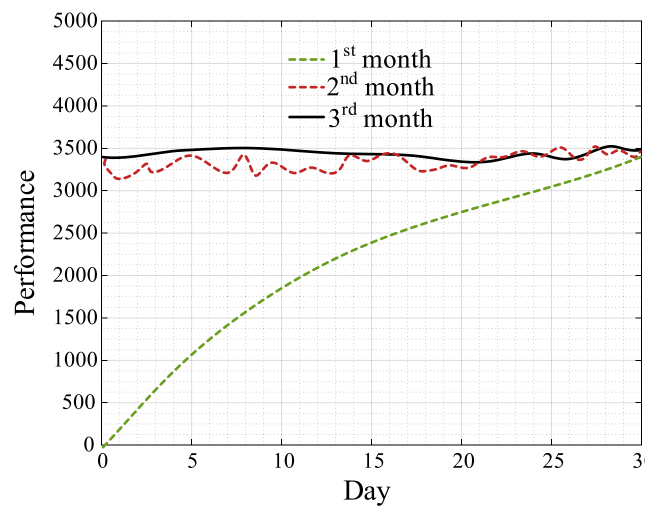

Fig. 4. Results of stability test.

3.2. Image pre-processing based on convolutional neural network

In this study, machine learning-based image feature extraction refers to the use of convolutional neural networks to extract image features. The purpose of image pre-processing based on machine learning is different from traditional image pre-processing. Traditional image pre-processing is to remove the interference of noise on feature extraction. For a convolutional neural network, it needs to learn the "methods" to obtain the characteristics of the extracted image data in various situations, so it needs a certain amount of data as a support, but in reality the amount of data cannot meet the needs. In addition, the convolutional neural network requires the input images to be the same size. What we need to focus on is how to choose a reasonable image processing method so that the size of the training data is consistent while ensuring that the features are as good as possible. Therefore, the pre-processing work of the convolutional neural network is the enhancement of image data and the regularization of image data. The purpose of image dithering is to improve the ability of the network to recognize wheel images collected under different lighting conditions. This article sets the image saturation, brightness, contrast and image sharpness which are used to change the color of the image. The purpose of image data regularization is to make the size of input image data consistent. The resolution of the original images is different. Most of the resolutions are too high and the amount of calculation is too large. Therefore, it needs to adjust the resolution of the image. The maximum width of the image is set to 480, and the maximum height is set to 640 when the image aspect ratio is maintained. In order to meet the requirements of the size of the input image of the network structure, the "Reshape" operation was used to adjust the image size to 224 by 224. Finally, the image is normalized. After processing, the data conform to the standard normal distribution with a mean of 0 and a standard deviation of 1.

$$x^{*} = \frac{x - \mu}{\delta} \tag{5}$$

The basic structure of a convolutional neural network is shown in Fig. 5. Product neural networks consist of neurons with learnable

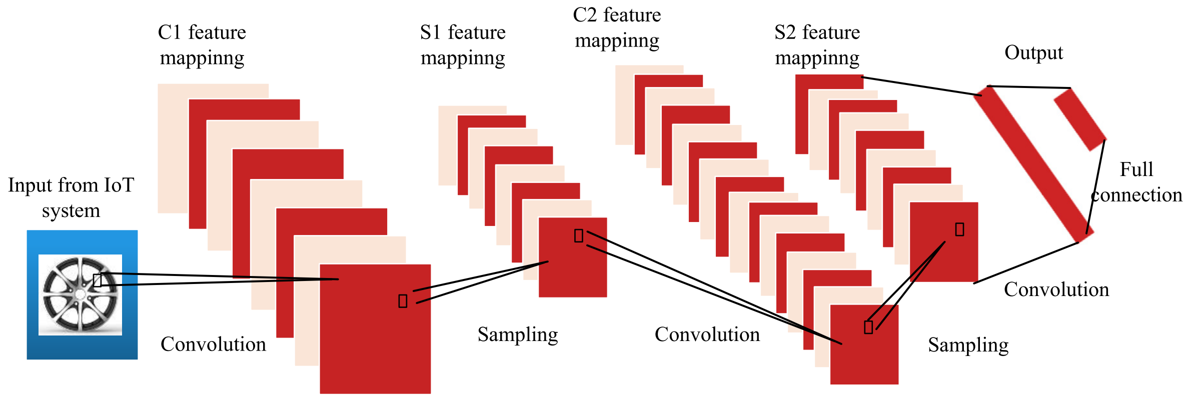

Fig. 5. Basic structure of wheel detection based on convolutional neural network.

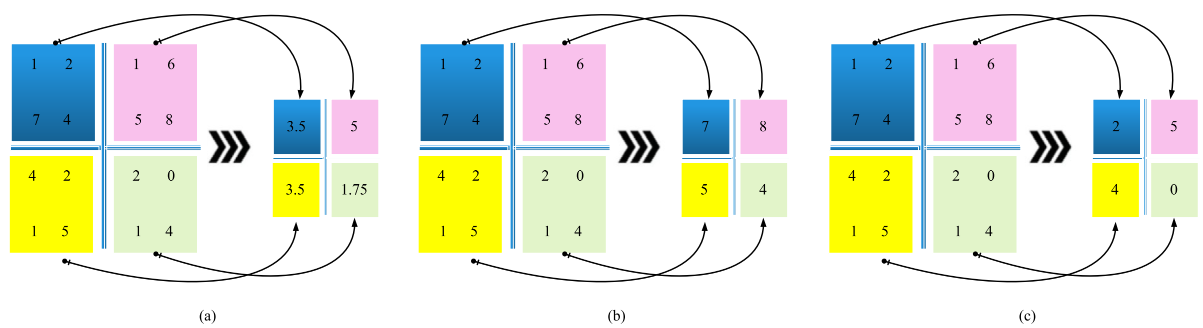

Fig. 6. Pooling layer operation: (a) maximum pooling, (b) average pooling, and (c) random pooling functions.

weights and bias constants. Its structure includes multiple convolutional layers, pooling layers, fully connected layers, and multiple activation functions. Pooling is also called downsampling. It can reduce the input image pixels and only retain some invariance of the pixels (such as rotation, translation, scaling, etc.), which effectively reduces the computational complexity. Currently, there are three types of pooling operations. They are maximum pooling, average pooling, and random pooling functions. The average pooling is to find the average value of the corresponding position of the convolution kernel, which can retain the background information of the image. The maximum pooling is to find the maximum value of the corresponding position of the convolution kernel, which can retain more texture information. The value of the pixel value of the corresponding position in the convolution kernel gives probability, and then samples according to the probability. The three pooling operations are shown in Fig. 6.

In the traditional computer vision method, the characteristics of wheel radius, center hole and moment of inertia are extracted. In the feature extraction of convolutional neural network based on machine learning, VGG network is used as the basic network. In the feature extraction of the convolutional neural network, the parameters of the trained data set are used as the initial parameters of the network, and then 70% of the collected wheel hub images are sent to the network as a training set for learning and network parameter update. The following compares the feature extraction effect from the four aspects of pre-processing work complexity, algorithm efficiency and classification accuracy, and algorithm robustness. In the pre-processing work, the traditional computer vision method requires feature extraction for each test. The difficulty of the pre-processing algorithm lies in the efficiency of the algorithm and the retention of effective features. Different from the traditional computer vision method, before using the convolutional neural network to extract features, image denoising and image segmentation are unnecessary. The pre-processing work is to enhance the training set data and regularize all the data. After the model parameters are updated and confirmed, the pre-processing only includes the regularization of the data. We only need to ensure that the input images are the same size, and its pre-processing is simple and efficient. In terms of algorithm efficiency, this article compares the average feature extraction time of each type of wheel image, and the specific experimental results are shown in Fig. 7 and Table 2. The efficiency of the two types of feature extraction methods is basically the same. The traditional feature extraction method is slightly better than the convolutional neural network feature extraction time. In order to verify the effectiveness of feature extraction, first, use the standard wheel front image collected on the wheel production line as a training set and a test set to classify the two types of methods respectively. Among them, SVM is used as a classifier for traditional features, and the neural network is used as a classifier for features extracted by convolutional neural networks. The classification accuracy results are shown in Table 3. It can be seen from the table that the classification effect of the two types of feature extraction methods alone can meet the needs of industrial detection. When using traditional methods to extract features, the classification results of the wheel image of NO. 3, NO. 5, NO. 7 are better. The three types of wheel image features are more obvious and the background interference of the image is less. When using a convolutional neural network for feature extraction, the effectiveness of feature extraction is much higher. The training dataset has a large amount of data and the type of data has a good classification effect. They can be completely classified. The effect of data feature extraction is not obvious.

Different from verifying the effectiveness of feature extraction, this study considers two aspects when verifying the robustness of the algorithm. First, this study hopes that the algorithm can have a certain anti-interference performance in the complex inspection environment, that is, it can still have the detection ability when the lighting environment changes or the camera is slightly disturbed. On the other hand, from the perspective of algorithmic models, through the analysis of the effectiveness of feature extraction and a large number of study referring to convolutional neural networks, this article believes that for

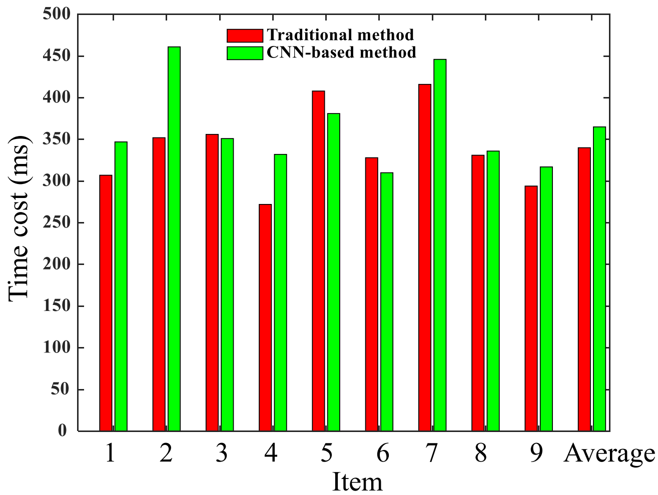

Fig. 7. Efficiency comparison of two methods, time cost (ms).

Table 2
Efficiency comparison of two methods, time cost (ms).

Items	Traditional method	CNN-based method
NO. 1	307	347
NO. 2	352	461
NO. 3	356	351
NO. 4	272	332
NO. 5	408	381
NO. 6	328	310
NO. 7	416	446
NO. 8	331	336
NO. 9	294	317
Average	340	365

Table 3
Efficiency comparison of two methods, accuracy results (%).

Items	Traditional method	CNN-based method
NO. 1	95.56	100.00
NO. 2	91.67	100.00
NO. 3	100.00	100.00
NO. 4	91.89	100.00
NO. 5	100.00	92.86
NO. 6	90.00	90.00
NO. 7	100.00	100.00
NO. 8	90.00	91.00
NO. 9	75.00	100.00
Average	94.18	97.10

convolutional networks, rich data can help them better learn how to extract Image-related features to improve the accuracy of its detection. Therefore, the training data set of the convolutional neural network in the robustness experiment includes three types of images: standard industrial detection images, non-standard industrial detection images, and random background images. The test data sets are standard industrial detection images and non-standard industrial detection images. The training set of the traditional method is a standard industrial test image, and the test set is a standard industrial test image and a non-standard industrial test image. It can be seen from Table 4 that the image features extracted by the convolutional neural network are far superior to the traditional method in terms of robustness, and the classification accuracy of the convolutional network is greatly improved after expanding the training data. The reason why the accuracy of traditional feature extraction methods is much lower than that of convolutional neural networks is that at the beginning of designing traditional feature extraction methods, the model assumed that the collected images were clear and complete images of the front of the wheel hub. The feature extraction methods used are based on this assumption. Therefore, for

Table 4
Efficiency comparison of two methods, robust performance (%).

Items	Traditional method	CNN-based method
NO. 1	75.36	100.00
NO. 2	79.63	100.00
NO. 3	82.54	100.00
NO. 4	79.37	100.00
NO. 5	82.86	100.00
NO. 6	81.08	100.00
NO. 7	78.95	94.74
NO. 8	81.82	96.97
NO. 9	71.43	100.00
Average	79.44	99.49

some random shots, the front features of the wheel are not clear, and the wheel detection images with complex background images cannot extract and retain effective features. Therefore, the image feature extraction effect of non-standard industrial pipelines is not good. Especially when the lighting environment changes and the camera's shooting angle deviates, the feature extraction effect is very poor. In contrast, for convolutional neural networks, when only learning standard industrial inspection images, the image data set is unevenly distributed, the data enhancement effect is limited, and the stability of its classification performance is poor. That is, it has excellent feature extraction for some types of wheels. After expanding the data range, the convolutional neural network balances the unequal learning ability between classes and improves the classification performance of the model. A further experiment found that the data classified incorrectly in NO. 7, NO. 8 are non-standard industrial inspection images, that is, the convolutional neural network can identify the standard industrial inspection images of the wheels, which is in line with the accuracy rate of industrial inspection.

4. Conclusion

Aiming at the problems existing in traditional image detection systems, relying on network networking and artificial intelligence technology, this study proposes the design of artificial intelligence image detection systems based on the Internet of Things. The architecture design uses cloud modules, image feature acquisition modules, and artificial intelligence signal image synthesis modules by making full use of IoT resource capabilities and artificial intelligence technology. Through simulation experiments, it is proved that the design of the artificial intelligence image detection system based on the Internet of Things has excellent performance indicators and meets the requirements of image detection. The design of artificial intelligence image detection system based on the Internet of Things provides new design ideas for the field of image detection system research and development. This article introduces artificial intelligence learning algorithms to wheel detection in the workshop under the Internet of Things system. The product neural network can be used to classify wheel images while integrating other detection requirements, such as wheel defect detection and wheel number identification. It cannot only solve the problem of poor feature anti-interference and poor robustness in the traditional method, but also has important significance for the secondary development of the wheel detection system. Based on the analysis of the indicators of the feature extraction scheme and classification scheme, classification schemes are given for the standard wheel valley classification task and a small sample of specific similar and different series of wheel classification tasks. The standard wheel classification task is analyzed from three aspects: algorithm efficiency, classification accuracy, and algorithm robustness. Finally, a convolutional neural network for feature extraction and a neural network classification scheme are determined as the wheel image classification algorithm. In the specific classification of different series of wheel hubs, because there are fewer wheel images of similar and different series, the convolutional neural network alone cannot extract effective features. Therefore, the contour circle radius and the moment of inertia feature of the traditional image are added, and the convolutional neural network is used. The method of combining the network and traditional methods can get the final classification scheme. Through simulation experiments, it is proved that the design of artificial intelligence image detection system based on the Internet of Things has the advantages of high image detection rate, high recognition accuracy, stable operation, and efficient processing. The design idea has good application value.

CRediT authorship contribution statement

Chengcheng Mo: Data curation. **Wei Sun:** Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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