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“Research on Information Management Based on Image Recognition and Virtual Reality”
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Research on Logistics Information Collection Based on Image Recognition

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ABSTRACT The logistics industry is an important part of the national economy and social life. With the rapid rise of e-commerce, the logistics industry is developing rapidly, and there are many problems due to the low level of automation in the sorting process. Therefore, improving the level of automation in the express sorting process is crucial to improving the efficiency of express sorting. In view of the above problems, this paper builds a logistics information collection model based on image recognition based on logistics information collection, combined with convolutional neural network for logistics image recognition. First, the current application status of information collection and image recognition in the logistics industry is described. Secondly, based on the existing image recognition technology, the convolutional neural network algorithm is used to quickly identify and collect information on logistics images. Finally, the case analysis and performance test results illustrate the superiority of the realized logistics information collection technology. This method can provide a scientific reference and basis for the modern logistics industry to adopt image recognition technology.

INDEX TERMS Stream information collection, image recognition, convolutional neural network, QR code

I. INTRODUCTION

With the rapid development of e-commerce, online shopping has become a new trend. A large number of express orders have driven the rapid growth of the total express delivery business. However, in the face of the rapid growth of express delivery business, the traditional express delivery industry operation model has gradually failed to keep up with the rapid development of e-commerce in terms of express delivery sorting. The traditional operation mode widely used by the express delivery industry that relies on manual sorting for express delivery is difficult to cope with. Many problems that have not been encountered before are gradually exposed, such as the loss of express delivery, the delay in delivery, and the violent sorting during the sorting process that cause damage to the goods. The resulting consequences not only increase the workload of workers, but also have low efficiency and extremely high rate of missed inspections and errors. Especially in the face of the shopping festival, the huge transaction volume and the sharp increase in the number of express deliveries have placed great pressure on the express sorting process. Manual sorting alone cannot meet the demand. Therefore, the research on logistics information collection suitable for small and medium-sized express delivery enterprises with low cost, small size, high degree of automation and high efficiency has gradually become the focus and research hotspot of many scholars.

In the field of logistics information collection, many scholars have carried out certain research and achieved fruitful results. Dr. Jun et al. proposed a method of locating one-dimensional barcodes with JPEG2000 compressed images. The position of barcodes was determined by analyzing the data of JPEG2000 image header files, and verified by wavelet encoding coefficients. When this method is used, the complexity of its operation is significantly higher than that of jpeg. Therefore, when it is applied to images, it is necessary to perform Huffman coding on the target images. Chai D. used the image blocking method to first divide the barcode image into 32 X 32 blocks, find the angle values of the parallel lines of the barcodes in each block, and then join the blocks with the same or similar angle values. However, the bar code image quality requirements are high during the processing, and some at least slightly poor image bar code areas cannot be completely recognized and extracted. Alexander T. et al. Proposed a method for locating barcodes based on the discrete cosine
transform (DCT) method. Firstly, the barcode part is distinguished from other regions by the characteristics of the DCT domain, and the morphological operation is used to smoothly detect the barcode region to locate the barcode. However, due to the uncertainty of the matrix weight coefficients in the algorithm, the method is less robust. Prof. Jain et al. based on different bar code texture characteristics and multi-channel Gabor filter technology, discussed the actual bar code positioning of flat surface images and complex curved surface images, but in the experimental process, the calculation cost of feature images the time is longer, the feature classification process takes about 3 seconds, and the experimental process takes about 32 seconds, which is obviously not suitable for the situation where the recognition speed is faster.

In view of the above-mentioned problems in the logistics information collection process, this subject takes the actual operation of the mail label image in the express mail sorting process as the research object, and completes the pre-processing of the mail label image in the captured high-definition image, the location of the QR code, and the QR code Research on key technologies in various links such as identification. Focus on the image processing process of pictures collected by high-definition cameras. Finally, the algorithm of this paper is used to analyze the performance of mail label barcode positioning and barcode recognition.

II. LOGISTICS INFORMATION COLLECTION TECHNOLOGY

The existing automatic sorting system for express delivery has not completely separated from manual assistance, and most of them use barcode or radio frequency identification as the information medium. But bar code and radio frequency identification have certain obstacles in application. Therefore, this paper has designed a sorting system for express delivery based on two-dimensional code recognition, which can not only realize unmanned sorting, but also avoid the disadvantages of barcode and radio frequency identification technology.

A. INFORMATION MEDIUM SELECTION

Many express companies have used barcodes as information media in express sorting systems instead of express information. The application of barcodes optimizes the information acquisition process of express sorting systems and improves system efficiency. However, the barcode itself has certain defects, such as small storage capacity and strong recognition directivity. These defects limit the further optimization of the entire process. Radio frequency identification technology is also used in the express automatic sorting system of some express companies. Needless to say, radio frequency identification has the advantages of rapid identification speed, large storage capacity, and strong security. These advantages seem to be very suitable for the automatic sorting system of express delivery, but the tag is expensive, and once damaged, the express delivery cannot be identified, and the radio frequency identification is very vulnerable in the complex metal environment. These shortcomings severely limit the possibility of radio frequency identification technology being promoted. As a newly emerging electronic media method, QR codes have attracted wide attention in various industries. Since the development of two-dimensional code technology, there are many types of QR codes. Among many types of two-dimensional codes, QR codes have gained more and more thanks to their advantages such as fast reading speed, large storage capacity, and strong error correction ability.

**FIGURE 1. QR code area structure diagram**

The abbreviation of QR code is derived from the abbreviation of "Quick Response", which translates to the meaning of quick response. The name is because the person who invented it hopes it can be decoded relatively quickly. The QR code can not only store a large amount of product content information, but also occupy a small area. It does not require a specific database to be decoded. The most important point is that its own code system has certain error correction capabilities, so minor damage will affect the recognition results.

The position detection pattern separator is a circle of shallow modules distributed on the outside of each position detection pattern. It is used to separate the position detection pattern and the coding area. As shown in Figure 2.1, it consists of a dot matrix of all "0" modules of. There are two types of positioning graphics, one is a horizontal positioning graphics and the other is a vertical positioning graphics. They are all composed of line...
segments with a module width and depth modules distributed between them, and must be started and ended by a darker module. Horizontal positioning graphics generally appear in the sixth row of the QR code from top to bottom, and vertical positioning graphics generally appear in the sixth column of the QR code from left to right. The function of correcting the graphic is similar to the position detection graphic, and it can also help to locate the QR code. And the structure is similar to the position detection pattern, which is also composed of three squares of different sizes but the center is coincident and the four sides are parallel. However, the length of the three squares in the correction pattern is 5, 3, 1 respectively. Generally, if the version of the QR code is different, the number of correction graphics it has is also different. The higher the version of the QR code, the more correction graphics. It is worth noting that the version 1 QR code does not contain correction graphics. The blank area is used to separate the QR code symbol area from the surrounding background and foreground pixels. It is composed of a "0" dot matrix with 4 module widths around the periphery of the QR code.

B. IMAGE ACQUISITION DESIGN

The image acquisition system realizes the function of acquiring the two-dimensional code image located on any side of the express, which is composed of six cameras, a four-degree-of-freedom mechanical arm and three photoelectric sensors. The cameras are divided into two groups, and each group has three cameras, which are respectively installed on the upper side and the two sides of the conveying equipment, and are used to collect the images of the express twice. The three photoelectric sensors are respectively installed on the front side of the first group of cameras, the second group of cameras and the turning robot arm relative to the running direction of the conveyor belt, and are used to provide them with signals of express arrival. The DOF mechanical arm is installed on the rear side of the first group of cameras relative to the running direction of the conveyor belt, and it is determined whether to turn over the express based on the photoelectric sensor signal on the front side and the computer processing signal. Among them, the mechanical arm that completes the flip action requires at least four axes, so the four-axis mechanical arm is selected as the flip arm.

Based on the hardware structure, the computer processes the collected express image and the information returned by the photoelectric sensor, and sends instructions to the robotic arm, thereby ensuring that the image of the two-dimensional code is collected without human assistance. First, the three cameras of the first group are installed in three directions of the conveyor belt 1. When the photoelectric sensor returns information 1, the first group of cameras takes a picture. At this time, the photo taken by the camera is the picture information on the three sides of the express number 1, 2, 3, and then the computer searches the three pictures collected to determine whether it contains a QR code, and transmits the instruction to the robot arm according to the result. The turning manipulator decides whether to act according to the command information transmitted from the first step and the information returned by the photoelectric sensor PS2. When the photoelectric sensor PS2 detects the shipment and returns the message 1: If the QR code is not found in the image returned by the first group of cameras, the robot arm 1 flips to the X-axis positive direction to express 1800. If a two-dimensional code is found in the image returned by the first group of cameras, the robot arm 1 does not move. Then the express enters the conveyor belt 2 perpendicular to the conveyor belt 1. Similar to the first group of cameras, the three cameras of the second group are placed above the conveyor belt 2, in the left and right directions, and when the photoelectric sensor returns information 1, the second group of cameras takes photos. In the first step, a total of six images were collected, and at least one of the six images contained a two-dimensional code image. If no two-dimensional code image was found, it was determined to be a problem.

III. IMAGE RECOGNITION TECHNOLOGY

FIGURE 2. Neural network structure model
The first thing image recognition technology does is to obtain important clues and information from the environment and classify objects. That is, the computer can recognize each target category included in the image scene according to different weather and different scenes. To accomplish this goal, a large number of different types of target images need to be used to train the perception model. After training and learning the perception model, the perception model will automatically recognize different types of target information in the scene based on the target features it has learned. The target needs the perception model to have a good recognition function, because even the same scene in the logistics information collection will affect the judgment segment due to the speed of the object, weather changes and other factors.

Alex Krizhevsky used neural network algorithms to reduce the classification error record from 26% to 15%. Since then, a large number of companies have begun to use deep learning as the core of the service. The research in this paper also uses the convolutional neural network in the neural network to realize the situational awareness task in traffic. Computers can also classify pictures by looking for low-level features such as edges and curves, and then construct more abstract concepts through a series of convolutional levels. The initial neural network is divided into input layer, hidden layer and output layer, as shown in Figure 2.

A. CONVOLUTIONAL NEURAL NETWORK

The convolutional neural network has made changes in the function and form of the layer and is further divided into a data input layer, a convolution calculation layer, a Relu excitation layer, a pooling layer, and a fully connected layer. Because the machine cannot have the visual effect of rapid recognition like humans, the pixel data of the image is the only way for machine recognition, so the data needs to be pre-processed such as averaging, normalization, PCA / whitening when the data is input. The principle of convolutional neural network is shown in Figure 3 below.

In the convolution calculation layer, each neuron is regarded as a filter, and the filter calculates the local data; the excitation layer will nonlinearly map the output of the convolution layer. The excitation function used is generally Relu; the pooling layer Sandwiched between successive convolutional layers, it is used to compress data and parameters, anyway, data overfitting. The neurons between each two layers will have the right to reconnect, usually fully connected at the tail of the convolutional neural network.

In this paper, the method of convolutional neural network is used for object target category perception. Convolutional neural networks can use the form of local connections to simulate the receptive field of living beings, and only extract information of a fixed size in the image, reducing the target parameters, and more conducive to processing. The use of convolutional neural networks to solve image recognition has the following three advantages.

1) Local connection. That is, each neuron will not be connected to all neurons in the previous layer, but only to a part of the previous layer to reduce parameters.
2) Weight sharing. A group of connections can share the same weight, or it can be used to reduce parameters.
3) Down sampling. You can use Pooling to reduce the number of samples per layer, further reducing the number of parameters. It is more conducive to visualization and target category recognition.

![Figure 3. Principle diagram of convolution neural network](image_url)

Training is the most important part of the neural network. We need to know how the filter of the convolution layer looks for the edge curve and how to adjust the weight of the filter, and then introduces the back-propagation algorithm. Because the expression ability of the linear model is not enough, we need to introduce an activation function to add nonlinear factors. The commonly used activation function is the Sigmoid function. Since the derivative of the Sigmoid is only near 0, it has better activation, and the gradient in the positive and negative saturation region Both are close to 0, and the phenomenon of "gradient disappearance" may occur, causing gradient dispersion, and the gradient of the Relu function in parts greater than 0 is constant, so there will be no gradient dispersion. In practical applications, the Leaky Relu function and the Randomized Leaky Relu function are not as effective as Relu. Therefore, this article uses Relu as the activation function,
which accelerates the training speed and overcomes the problem of gradient disappearance.

**B. BACK PROPAGATION ALGORITHM**

Training is the most important part of the neural network. We need to know how the filter of the convolution layer looks for the edge curve and how to adjust the weight of the filter, and then introduces the back-propagation algorithm. Because the expression ability of the linear model is not enough, we need to introduce an activation function to add nonlinear factors. The commonly used activation function is the Sigmoid function.

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Relu function: \( F(x) = \max(0, x) \) accelerates the training speed and overcomes the problem of gradient disappearance.

![Schematic diagram of the Relu function](image)

The idea of back propagation is actually that for each training instance, it is passed into the neural network to calculate its output. Then measure the output error of the network (that is, the difference between the expected output and the actual output), and calculate how much error each neuron in the previous hidden layer contributed to the output result; repeatedly calculate from the next layer to the previous Layers until the algorithm reaches the initial input layer. This reverse transfer process effectively measures the error gradient of all connection weights in the network, and finally optimizes the parameters of this layer by applying a gradient descent algorithm in each hidden layer.

The back-propagation formula of the output layer:

\[
\hat{c}^L = f'(u^L) \circ (y^n - t^n)
\]

\[
\frac{\partial E}{\partial w^\tau} = x^\tau - (\delta^\tau)^T
\]

\[
\Delta w^\tau = -\eta \frac{\partial E}{\partial w^\tau}
\]

Output layer error:

\[
E = \frac{1}{2} \sum_{k=1}^{L} (d_k - o_k)^2
\]

\[
P(X=x/Y=c_k) = P(X^{(1)}=x^{(1)}; X^{(2)}=x^{(2)}; \ldots; X^{(l)}=x^{(l)}) / Y=c_k
\]

\[
= \Pi_{j=1}^{n} P(X^{(j)}=x^{(j)}/Y=c_k)
\]

Constructed conditional independence for conditional probability.

\[
P(Y=c_k/X=x) = \frac{\Pi_{j=1}^{n} P(X^{(j)}=x^{(j)}/Y=c_k) P(Y=c_k)}{\Sigma_{k=1}^{K} \Pi_{j=1}^{n} P(X^{(j)}=x^{(j)}/Y=c_k)}
\]

In which, \( d_k \) is the kth layer of the data sample, \( o_k \) is the kth layer of the network output, the input layer, the output layer and the hidden layer

\[
\Delta w^\tau = -\eta \frac{\partial E}{\partial w^\tau}
\]

When testing the feasibility of the model, it is more intuitive to convert the scores obtained by classification into probability values. In the neural network, the SoftMax classifier is between the hidden layer and the output layer. The purpose of using the SoftMax function is to compress a k-dimensional arbitrary real number vector into another K-dimensional real number vector, each of which has a value between (0,1).

Hypothetical function:

\[
h_\theta(x) = \frac{1}{1+e^{\theta^Tx}}
\]

\[
\sigma(z) = \frac{e^z}{\sum_{k=1}^{K} e^z}
\]

The SoftMax algorithm can be used to solve multi-category classification problems, using a hypothesis function to estimate its probability value and normalize it to make the sum be 1. The cost function of the model is

\[
J(\theta) = -\log \sum_{j=1}^{K} \frac{e^{\theta^T x_j}}{\sum_{k=1}^{K} e^{\theta^T x_j}}
\]
perform multiple iterations to make the result fall into the global optimal solution as much as possible.

IV. LOGISTICS INFORMATION ACQUISITION FRAMEWORK BASED ON IMAGE RECOGNITION

Mathematical model refers to a model constructed with mathematical language using mathematical logic methods. The development of the Internet has resulted in a large amount of data accumulation. Massive digital logistics images have brought a wealth of "data food" to the researchers of logistics information collection. With the constant attention to data value mining, in recent years, there have been endless ways to study and analyze logistics information from the perspective of graphic images and mathematical statistics.

A. TECHNOLOGY ARCHITECTURE

1) ACCESS LAYER
The access layer can also be referred to as the data collection layer, and its role is through various data collection methods (for example: analog cameras, various sensors, RFID radio frequency identification, two-dimensional codes, alarm detectors, temperature sensors, vehicle positioning systems, etc.) After obtaining the data, you can collect the dynamic information of the vehicle and cargo status through the access layer. Through continuous data collection, the data accumulation is realized, which lays the foundation for big data mining.

2) DATA PROCESSING LAYER
The data layer is an important part of logistics information collection. The access layer uses image recognition technology to collect massive unprocessed data and transmit it to the data layer through the optical fiber network cable. The data is processed and classified into different databases for storage management. In addition, the use of data exchange technology to achieve data exchange and sharing, thereby enriching the accumulation of database data. The data layer also uses a variety of advanced cloud computing data processing technologies to dig deep into the data and pave the way for data decision-making applications.

3) PLATFORM LAYER
The platform layer mainly completes system integration and data processing. The platform layer needs to use technical means to integrate the existing information systems of various departments, and perform deep self-configuration processing of the data collected by various subsystems, and complete deep processing and storage of data through database servers and large enterprise-level databases. The platform layer combined with the data layer can complete the main data processing of the information platform, and can achieve data filtering, exchange, analysis, and mining between various systems to support the application needs of different users at the application layer. At the same time, this layer is responsible for the regular maintenance of the system, data encryption and security protection.

B. DATA CENTER

The dense data center established by this logistics information collection further ensures the stability of the system and the need for further processing of the required data. A disaster preparedness center, two data centers, and two production centers constitute the system's information assurance system. The disaster preparedness center consists of one EMC CX700 disk array and two IBM P650. The system consists of a data support center consisting of a data production area, a data exchange area, and a final decision area. The data generation area of the center includes data accumulation for logistics information collection. The decision-making area of the center refers to the macro decision-making information database that can generate conventional statistical tables and sample surveys.
The above information database can cover the most comprehensive data and information of the system.

V. EMPIRICAL CASE ANALYSIS OF MUSIC VISUALIZATION

The above describes the design and implementation of logistics information collection. In order to verify the feasibility and efficiency of the logistics information collection based on image recognition proposed in this paper. We will conduct functional tests on the system to analyze and verify the practicability and efficiency of the system.

A. CASE TEST ENVIRONMENT

When testing the logistics information collection system, the configured test environment is shown in Table 1. In addition, the application server and database server all use Inter L5520 type CPU, Centos-6.5 system, and the database is MySQL 5.5.28.

| Test Environment | Application Server | Database Server |
|------------------|---------------------|-----------------|
| CPU              | Inter L5520         | Inter L5520     |
| RAM              | Kingston 2G         | Kingston 2G     |
| OPERATING SYSTEM | Centos-6.5          | Centos-6.5      |
| MIDDLEWARE       | APACHE TOMCAT 7.0.79|                 |

B. SYSTEM PERFORMANCE TEST

During the system design, multiple data security mechanisms are adopted to ensure reliable data transmission. On the one hand, while the logistics information data is transmitted in real time, the data is stored locally for a short period of time. On the other hand, when a small amount of data loss occurs, the instant retransmission mode can be started, that is, when data packet loss occurs, the system starts the instant data retransmission mechanism, without affecting the real-time data transmission, using the real-time transmission gap will be lost The data is sent back to the data server. When the network is disconnected for a long time or the network signal is poor resulting in a large amount of lost data that cannot be transferred in real time, the system will issue an alarm prompt.

In the process of system performance testing, the two indicators of system response time and packet loss rate are used to test the concurrent performance of the system and the performance of responding to customers. Limited to the network environment and server performance have a greater impact on performance indicators, the network environment during the test is selected as the internal network, the server is a stand-alone server with a brand-new system and a cluster with two stand-alone servers. It can be seen from the test results that the packet loss rate of wireless data transmission is <0.1%, and 99% of the packet loss data can be retransmitted successfully. Only device No. 5 has a low battery power when the packet is lost, and one data packet is not turned on due to the device shutdown. After the device is turned on next time, the data can still be retransmitted successfully, thereby ensuring the integrity of the data.

| Clustering | Factor 1  | Factor 2  | Factor 3  | Quantity | Proportion% | TYPE |
|------------|-----------|-----------|-----------|----------|-------------|------|
| 1          | -1.037    | -4.214    | 25.308    | 1        | 0.02        | 001(1) |
| 2          | -1.085    | -5.657    | 39.602    | 1        | 0.02        | 001(1) |
| 3          | 0.6702    | 2.852     | 0.0846    | 227      | 4.24        | 111(7) |
| 4          | -0.5124   | -0.497    | -0.128    | 2570     | 47.99       | 000(0) |
| 5          | 0.6924    | 0.25      | 9.9656    | 13       | 0.24        | 111(7) |
| 6          | -0.3458   | 0.625     | -0.024    | 1372     | 25.62       | 010(2) |
| 7          | -0.1142   | 0.548     | 2.9686    | 106      | 1.98        | 011(3) |
| 8          | 1.5441    | -0.262    | -0.157    | 1065     | 19.89       | 100(4) |

C. SYSTEM TRIAL FEEDBACK

In order to test the reliability of the parameters of the logistics information collection technology in the actual use process, we organized various types of system tests. Taking the use of feedback from a logistics enterprise that tried the logistics information collection as an example to analyze the effect, the evaluation data of the enterprise's use of different businesses of the system within 2 months was collected.
As shown in Figures 6 and 7, after trying out the logistics information collection technology, the image recognition efficiency of some logistics products of the enterprise was stable, and no recognition fluctuations caused by technical reasons occurred. And the above logistics products 1 and 2 have high recognition accuracy and stability. After the establishment of logistics information collection technology based on image recognition technology in the system, good logistics services and experience have effectively increased the sales and revenue of corresponding products.

As shown in Figures 8 and 9, compared with other image recognition technologies, the convolutional neural network adopted in this paper has a leading advantage in performance stability and efficiency. After the trial of this logistics information collection technology, the number of disputes related to logistics products has been greatly reduced within two months, indicating that the increase in customer satisfaction with the purchase of related products will help increase the credibility and sales of related logistics products. Through the investigation of user satisfaction, due to the intuitive and efficient characteristics of the technology, user satisfaction has been improved in a short time, which is conducive to the further development of the logistics industry informatization process. The logistics information collection technology will also provide a reference for the development of similar logistics information collection technology in the future.

V. CONCLUSION
This paper studies the logistics information collection based on image recognition. The system uses convolutional neural network for image recognition, real-time collection of logistics images, and data processing and data analysis through convolutional neural network. The actual case test and analysis illustrate the good effect of the logistics information collection technology.
technology, which can provide a scientific reference model and basis for the establishment of remote real-time dynamic logistics information system using image recognition technology. In addition, this paper mainly analyzes the application of convolutional neural networks such as big data analysis and other techniques. The application of logistics information needs to be deepened and studied at the data mining level. Focusing on the increasing and deepening demand for the logistics industry in the future social development, we will continue to tap and improve existing logistics technologies to provide scientific assistance for the logistics industry.

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