Design of Barcode Recognition System Based on YOLOV5

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Abstract. In this paper, based on the research focus of the current logistics field, a deep learning based express single-side bar code extraction algorithm is designed. This algorithm can recognize the original image and read out the information of the package. The algorithm is divided into two parts: bar code localization algorithm and bar code recognition algorithm. To avoid high delay, we use the YOLOV5S network to complete the barcode localization algorithm. First, the YOLOV5S algorithm is used to frame out the barcode, and the bounding Box is cut off. Then, OpenCV's method is used to obtain the deflection Angle of the image. Finally, affine transformation is used to correct the images with deflection. The bar code recognition algorithm is to use ZBAR algorithm to decode the bar code and output the decoded content in the form of string, and finally realize the location and recognition of the bar code on the single side of the express. Finally, through the test of the data set, it can be seen from the experimental results that this paper has accomplished the goal well.

Keywords: Barcode; Yolov5; Identification; Positioning.

1. Introduction
With the rapid development of China's economy, people's income level is also increasing, consumers are more and more enthusiastic about convenient online shopping, and e-commerce is also developing rapidly from scratch. According to the survey data, in 2019 China's express delivery business volume exceeded 60 billion pieces, totalled 63.52 billion pieces, up 25.3% year on year, and the incremental scale exceeded 10 billion pieces for two consecutive years. The average daily handling capacity of express delivery enterprises in China exceeded 170 million pieces, up 25.3 percent year on year, and the maximum daily handling capacity reached 540 million pieces, up 28.5 percent year on year. The revenue of express delivery business reached 749.78 billion yuan, up 24.2 percent year on year. In 2020, the Courier industry was greatly affected by the epidemic. However, as enterprises resumed work and production, the average daily volume of express delivery in China has been close to 260 million since June. However, the development time of China's express industry is too short, and the operation mechanism of the whole industry is not sound enough, leading to the low efficiency of express terminal, prone to overstock and other problems, which has caused the dissatisfaction of many consumers, and caused economic losses to express companies.

With the first proposal of "intelligent logistics", improving the intelligence and automation of logistics system has become the focus of research in today's logistics field. Therefore, the use of barcode to store information in the field of logistics has emerged. By identifying the barcode, customer information and express delivery information can be retrieved in the database. Barcodes have made logistics smarter, but there are still some problems. For example, bar code printing is not qualified, or the bar code is damaged in the delivery process, which will lead to the success rate of bar code reading.

Aiming at the limitations of the bar code mentioned above, this paper focuses on an efficient algorithm for extracting bar 2-codes from a single express. This algorithm is based on deep learning to locate and
identify the bar codes on the express bill. From the result, the algorithm can significantly improve the efficiency of bar code identification, thus promoting the construction of “intelligent logistics”. This paper mainly aims at the proposal of “intelligent logistics” to better improve the intelligence and automation of logistics system and proposes a deep learn-based single-side bar code localization and recognition algorithm for express delivery.

2. YOLOV5 Algorithm
YOLOV5 provides four versions of the target detection network, namely YOLOV5S, YOLOV5M, YOLOV5L and YOLOV5X. The width and depth of the four versions of the network increase in the order as shown above, and the size of the weight file will gradually increase. The reasoning time will be longer, but at the same time, the accuracy of the reasoning will also be improved correspondingly. The specific representation of these four models can be referred to Fig.1.

![Figure 1. Network performance of each version of YOLOV5.](image)

Considering the need for low delay in practical application, this paper adopts Yolov5S network to complete the calibration of the barcode position on the express bill. The structure of this network can be roughly summarized as shown in Fig.2.

![Figure 2. Network structure of Yolov5S.](image)

3. System Design

3.1. System Architecture Design
The system design architecture in this paper is as following. First, input the picture to be detected, then use the Yolov5 algorithm to box out the barcode and intercept the selected part of the Bounding box to obtain a picture with the barcode as the main information. Use OpenCV's method to get the deflection angle of the picture, then use affine transformation to correct the deflection of the picture, and finally use ZBar algorithm to decode the barcode image after processing and output the decoded information in string format. Finally achieve the express waybill on the bar code calibration.

3.2. Data Sources
The production of the data set in this paper is divided into three steps. First, the camera of MIX2S is used to take photos and collect the physical express waybill. Then, the Labelling tool is used to select and mark the bar codes on the collected express waybill, including different express companies and different sizes. Sample images from different angles and under different lighting conditions. Finally,
Mosaic is used to enhance the data of all samples during the training, which improved the detection ability of the model to small targets. In addition, a series of data enhancement coefficients, such as hue, saturation, brightness degree, rotation Angle, translation, scaling, and flip, are adjusted to further enhance the training data and improve the generalization ability and reasoning accuracy of the model.

3.3. Experimental Parameter Setting

| Parameter names       | Parameter definition     | Value    |
|-----------------------|--------------------------|----------|
| lr0                   | vector                   | 0.0032   |
| lrf                   | Cosine annealing hyper parameter | 0.12     |
| momentum              | Learning rate momentum   | 0.843    |
| weight decay          | Weight attenuation coefficient | 0.00036 |
| batch-size            | Batch size               | 32       |
| epochs                | Number of training       | 100      |
| weights               | weight                   | random   |
| device                | Training equipment       | GPU      |

3.4. Experimental Process

Initially, we intend to use only the edge detection algorithm in OpenCV to locate the bar code, but we soon encounter two problems that were difficult to solve. One problem is that on some express waybills, many words are filled in the column of the delivery address, and these words are arranged very neatly in the vertical direction and the spacing between the lines is very small, so that it is like the bar code, with a small vertical gradient and a large horizontal gradient. The application of edge detection algorithm in bar code localization utilizes this feature of bar code and uses the horizontal edge detection of Sobel operator to achieve this function. Therefore, this directly leads to the failure of edge detection. Another problem is that the bar code's horizontal gradient decreases as the image deflects more and more. Similarly, this eventually leads to edge detection failure.

In the subsequent experiments, we also find that the robustness of edge detection is very poor, and objective factors such as lighting conditions, shooting Angle, shooting background and so on would have a great impact on the detection results, which eventually force us to give up this scheme. Later, we turn our attention to the Yolov5 target detection algorithm. However, due to the large amount of personal privacy information on the express order, it was extremely difficult to collect the data. The collected data is provided by the team members. Therefore, when we use Yolov5 for training, we use a variety of data enhancement to avoid overfitting of the model and enhance the generalization ability of the model, and finally obtain good experimental results. (The experimental results are shown in Fig.3 and Fig.4)

Figure 3. Training results of Yolov5.
After using Yolov5 algorithm to complete the positioning of the bar code, we also need to correct the bar code with too large deflection Angle. The first step is to intercept the range selected by Bounding Box. In the second step, the edge detection algorithm in OpenCV is used to process the intercepted image, and the minAreaRect() method is used to get the deflection Angle of the image, and then the affine transformation is used to correct the deflection image. At last, the ZBar algorithm is used to decode the corrected image, and the decoded information is outputted in string format and written into a text file, finally realize the function.

4. Conclusion
This paper introduces the process of calibrating and analyses the barcode on the express way bill by using YOLOV5, OpenCV computer vision and the ZBAR decoder. We use the self-collected and produce training set to train on the YOLOV5S network. During the training, we adjust a series of hyper parameters and use a variety of data enhancement to make the model which have a strong generalization ability in the case of few training pictures. In this paper, YOLOV5 algorithm is mainly used to eliminate interference as much as possible to obtain accurate image deflection, and finally achieve a strong robust bar code recognition system.

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