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Design and Development of Inventory System Based on Barcode Scanning Technology

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Abstract. The inventory machine is a device for managing the use of goods. In order to achieve the high efficiency and accuracy of data collection, processing and transmission of goods on site, a system of inventory machine based on barcode scanning technology is designed and developed. The system uses Java as programming language and designs a reasonable barcode scanning recognition mechanism. The external interference factors affecting barcode recognition and the problem that dirty barcode cannot be recognized are studied. Digital image processing technology is added to the inventory machine system, which improves the scanning speed of the inventory machine and the correct rate of barcode recognition. Through on-site testing, the system being developed meets the requirements of the enterprise for the inventory machine, and can complete the inventory and settlement of goods information efficiently and accurately in a fixed time. Compared with the previous use of the inventory machine, the cost and manpower cost in barcode scanning time are greatly reduced.

1. Introduction

Under the background of rapid development of market economy, the storage period of goods warehouse becomes shorter and the pressure of liquidation becomes greater, which makes enterprises need professional inventory equipment to manage a large number of goods data in circulation, including the statistics and records of its stock, loss, sales quota and other related information. In the traditional inventory machine system, the clearness of the barcode of the scanned goods is required to be high, and it needs to be in good condition to information collection. If there is dirt or even the tiny flaws, the relevant department needs to re-search and print the clear barcode before collecting. Not only is a lot of time wasted, but also is very complex to implement. Therefore, the function of the inventory machine system will directly affect the overall operating cost of the company, and barcode recognition plays an important role in the efficient collection and correct storage of goods information. Therefore, it is necessary to update the function and technology of the inventory machine system. Considering the inventory machine application occasions, the external environment will have a greater impact on the scanning and recognition of the barcode image. So far, it is necessary to study and design a reasonable barcode image recognition process to ensure the correctness of image acquisition, recognition and data analysis and transmission. Combining the characteristics of barcode, focus on solving the problem of image quality degradation caused by noise interference in the actual identification barcode image. Improve the signal-to-noise ratio by improving the noise reduction algorithm, improve the image sharpness, repair the micro-loss barcode image, and reduce the recognition error and the time it takes to scan a single barcode, make the operation simple and reasonable, and easy to use the inventory personnel.



2. Improvement Design of Barcode Scanning in Inventory Machine System

The use of the inventory machine is usually in the warehouse or stores, and it is necessary to consider the influence of lighting environment, humidity and other factors on the barcode recognition. The design idea improves the barcode recognition mechanism suitable for the inventory machine system, screens and compares the digital image method, selects the optimal barcode image processing technology, and adopts the bidirectional scanning recognition method, so that reduces the opening scanning time consumed by the inventory machine system and improves the barcode recognition accuracy. The flow of barcode recognition technology in the improved inventory machine system consists of barcode image acquisition, barcode image preprocessing, barcode decoding and other aspects. Finally, the detailed commodity information data is obtained for transmission and stored persistently.

2.1. Barcode Image Acquisition

The barcode is a parallel line pattern consisting of black bars (bars) and white space (empty) with very different reflectivity. When the inventory machine collects the barcode image, the system needs to initialize the scanning thread, and simultaneously turn on the light source and the scanning beam to solve the problem that the barcode cannot be recognized due to the dim light, and adapt to warehouse field operation. The scanning light sets the centerline reference and the range frame, which adjusts the length and size with the push and pull of the inventory staff's arm, and can adapt to long-distance focus acquisition.

2.2. Barcode Image Preprocessing

The preprocessing of the barcode image by the inventory machine does not need to be very complicated. It is necessary to highlight the barcode image and emphasize the recognition of correct barcode information. The improved barcode image preprocessing includes the following steps: grayscale, noise detection based on Gini impurity, median filter denoising, and local adaptive binarization.

2.2.1. Barcode Image Grayscale Processing. The barcode image collected by the inventory machine contains colour information, and the occupied system storage space is large, and calculates a lot of data in the subsequent processing. The system should perform the grayscale preprocessing of the collected barcode image firstly in order to improve the processing speed. In the inventory system, the weighted averaging method is used to grayscale the scanned barcode image, and the generated image data is simple to process and is easy to use by the inventory system.

2.2.2. Noise Detection Based on Gini Impurity and Median Filtering Denoising. The barcode image collected by the inventory machine will produce noise because of its processing process and data transmission circuit. Generally, salt-and-pepper noise will be generated in barcode image after grayscale processing. Median filter is usually used to denoise. Therefore, the median filter denoising method has been improved to make it more suitable for the inventory system. The main idea is to first detect the noise of the scanned barcode image based on Gini impurity to determine whether the node types in the subset of the pixels are identical. If the pixel is determined to be a noise point after detection, then the median filtering method is used to remove noise. Finally, the barcode image after denoising is obtained.

The concept of Gini is proposed in the decision tree of solving nonlinear regression problems in machine learning algorithms. It is used to measure the ratio of each type in a set. The expression is as follows:

$$\text{Gini}(t) = 1 - \sum_{i=1}^j P(i/t)^2 \quad (1)$$

Where, j is the number of types, t is a subset of samples, and $P(i/t)$ is the probability of selecting a type i from a subset of nodes. When the Gini impurity is 0, it means that the node types in the set are consistent; when the Gini impurity is not 0, the node type in the set has an error rate. Any point in the image can form a set with the surrounding pixels to calculate its Gini impurity. When noise points appear in the clean set of pixels, the value of Gini impurity will not be 0, then, it will be denoised by median filtering.

Median filtering denoising is to take a pixel as the central point and form a square matrix. The grayscale values of the pixels in the matrix are sorted, and the intermediate grayscale values of the ordered sequence are taken as the new grayscale values of the pixels. The barcode image has its particularity. When the median filter is used for denoising, the top, bottom, left and right pixels of the central point are traversed to form an ordered sequence. The median value is taken to reduce the amount of arranged data, and the loop traversal denoising method is adopted.

2.2.3. Barcode Image Local Binarization. The local binarized Wallner algorithm is selected in the inventory machine to quickly and adaptively binarize the denoised grayscale barcode image. The Wallner algorithm assumes that the grayscale value at point n in the image is Gray_n , then the sum of the grayscale values of the first s pixels at point n is $g(n)$, the expression is as follows:

$$g(n) = \sum_{i=0}^{s-1} \text{Gray}_{n-i} \quad (2)$$

After binarization, the grayscale value of the pixel is expressed as $\text{Gray}(n)$, and whether $\text{Gray}(n)$ is 1 (black) or 0 (white) depends on the selection of the threshold. The threshold is $(100 - r/100)$ times the average grayscale value of the first s pixels. According to the actual test, the best value range of s is $(\text{image.width}/8)$, and the effect is best when r is 15.

2.3. Bar Code Decoding Processing

Considering the application of inventory machine in logistics enterprises, it is necessary to satisfy the diversity of the decoding range, and it is not limited to identifying one or several barcodes, but needs to identify more than a dozen different codes. The main ones are EAN code, Code128 code and Code39 code, etc. The code value of the barcode is identified according to the width and the space of the bar in the scan bar code. In order to determine the position information of the characters in each bar code, the inventory machine system performs a global search within the upper and lower boundaries that have been scanned to find the right edge of the last bar to form a width sequence. The number, width, and other identifier information contained in the barcode are identified based on the width array.

3. Design of Inventory Machine System

Based on the barcode scanning technology of the inventory machine system, the development architecture is shown in Fig.1, using Java as the programming language. Among them, the APK of client is installed in the inventory system, and the operation will generate an .arr file contains the program source code and resource files to facilitate the update and migration of the version. Using the Plugin plug-in processing is a complete, stable, and fully-used, hole-occupying plug-in method, which enables plug-ins to run independently, facilitates business expansion, and improves complementary system functions.

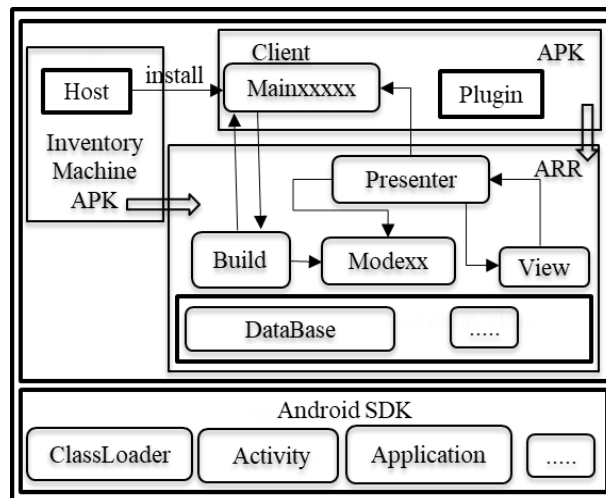


Fig.1. Inventory machine development architecture

Barcode scanning is implemented in the Presenter class. Take the barcode scanning in the inventory picture as an example. First, the activity class implements the redrawing of the inventory machine interface, call the middleware ADBC to start scanning the scan thread, opens scanning beam to scan barcode, and rewrite the three interfaces, respectively, successful callback of ScanComplete scanning, error callback of ScanError scanning code, and callback of CaptureComplete photography. The code is as follows:

@Override

```
Public void onScanComplete (int var1, String[] var2,int[] var3) {
```

```
    If(mPresenter != null){
```

```
        Message msg = new Message();
```

```
        If(var1 > 0){
```

```
            msg.what = var1;
```

```
            msg.obj = var2;
```

```
            handler.sendMessageDelayed(msg,
```

```
            delayMills:0);}else{
```

```
            LogToFile.getSingleton().d("ContActivit", "onScanComplete var2 =");
```

```
        }
```

```
    }
```

```
}
```

@Override

```
Public void onCaptureComplete(Bitmap var1){
```

```
}
```

@Override

```
Public void onScanError(int i){
```

```
}
```

Scanning management subclass will give prompt information for different scanning results. After the check button of the inventory personnel, the next barcode scan operation will start. After the scanning, the system defines the scanning process, transmission protocol and so on according to the operation of the inventory personnel, determines that the scanned barcode data is transmitted to the database by wireless or wired mode for persistent storage, and realizes the instant access and ready use of the field data.

4. Experimental Results

The actual test of the inventory machine should be used in the warehouse of goods, and the barcode of goods should be scanned on the spot. According to the requirements of the merchants, the inventory of

their stores should be counted within 3 hours, and the inventory quantity of goods and damage data can be counted. After verification, the given amount of tasks can be completed within the expected unit time, without affecting the normal business of the merchants. Compared with the time used by the merchants in the past, the counting time used by the merchants has been reduced, and the efficiency has been improved by 20%. Therefore, the barcode scanning mechanism designed in the inventory machine system is reasonable and feasible.

5. Conclusions

The scanning and recognition technology of barcode in the inventory machine was systematically researched and designed. The key technology of computer image processing was applied to identify the barcode image, and carries out field test combined with the actual use scenario. It overcomes the problems caused by environmental factors, improves the accuracy of barcode information input, and reduces the time cost of single barcode scanning and recognition. The innovation of key functions in the inventory machine will maximize its role in the inventory process and accumulate experience for the localization of the inventory industry in the future.

References

- [1] WANG Qiong, KANG Kai, ZHU Yongbo. Study and Application of Pattern Recognition Technology Based on the Barcode Tracking and Management System[J]. Automation & Instrumentation, 2016, 31(08): 19-24.
- [2] Mei Qicheng. The Research of Commodity Image Recognition Based On Deep Learning[D]. Guangdong University of Technology, 2018.
- [3] Du Shusheng. Based on the android to take stock equipment of the software system of design and implementation[D]. Tianjin University, 2016.
- [4] Zhang Dezhen, Zhang Zifang, Yu Zhongwei, etc. Data acquisition and processing system for on-line production based on inventory machine [J]. Computer Engineering and Applications, 2008(22): 222-225.
- [5] S. Arnould, G. J. Awcock, and R. Thomas, Remote bar-code localization using mathematical morphology, Proceedings of IEE Seventh International Conference on Image Processing and Its Applications, 2, July, 1999, pp. 642-646.