Intelligent Recognition of Production Date Based on Machine Vision

To cite this article: Xiaona Sun et al 2019 J. Phys.: Conf. Ser. 1267 012041

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Intelligent Recognition of Production Date Based on Machine Vision

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Abstract. Aiming at the problems of large work intensity, low intelligence level and low efficiency, the production date intelligent recognition algorithm was designed. The algorithm optimizes the image preprocessing algorithm, combines the grid statistical method and the projection density method to extract the feature vector, and uses the support vector machine algorithm to identify the production date. The experimental results show that the algorithm can accurately identify the production date and achieve the expected recognition effect. Has practical significance.

1. Introduction
Machine vision [1-2] is one of the important directions in the development of artificial intelligence. Using the machine instead of the human eye to complete the judgment and detection has a broad application prospect, converting the acquired target into an image, and transmitting the signal to the image processing software, using digital image processing technology [3] to obtain various information of the target, according to the identification The result is to control the operation of the device.

In recent years, with the increase of residents' income and health concerns, people are paying more and more attention to the safety of food. The date of production of food is an important factor in determining food safety, which directly determines whether the food has reached the edible condition. Accurate identification of production date information is particularly important.

This design proposes a code identification algorithm applied to the outer packaging production date. Through the acquired image preprocessing, ROI region extraction, segmentation correction, recognition and other technologies, the production date information is obtained, and the production date is recognized. The research on the quality inspection of dairy products provides a reference.

2. Overall overview of production date intelligent identification

2.1. Intelligent identification system overall framework
The intelligent identification of production date mainly includes two parts, hardware acquisition system and software processing system. The hardware acquisition system mainly includes camera, light source, photoelectric sensor, sealing cover, industrial computer, etc. The distribution of hardware system is shown in Figure 1 below. Hardware acquisition system The collected image is transmitted to the software processing system, and processed by the image preprocessing algorithm and the image
recognition algorithm to identify the production date. The overall frame of the identification system is shown in Figure 2.

2.2. Intelligent identification system algorithm flow

The intelligent recognition algorithm based on production date mainly includes two kinds of algorithms, image preprocessing and character recognition algorithm. The former mainly lays the foundation for the latter's implementation, and directly affects the recognition effect, including image denoising and removal due to hardware facilities. Noise interference caused by the environment, improve the contrast of the image; image positioning, used to locate the region of interest, extract the production date area; character correction, because the segmented character will have a certain direction of rotation, correct it to the horizontal direction It is convenient for character segmentation; character segmentation divides the production date characters into single characters to facilitate the extraction of character features. This paper is based on SVM [4-6] neural network algorithm to identify characters, including character normalization, feature extraction, and character training. The algorithm flow is shown in Figure 3.

3. Preprocessing algorithm implementation

3.1. Location Algorithm

In this paper, the adaptive anti-rotation template matching method is used for positioning. Firstly, the image is filtered to reduce the noise interference during matching. Then, the multi-angle template library is built by rotating the image to be recognized to solve the false contour caused by the template rotation. Finally, the normalized product correlation algorithm optimized by FFT and integral graph principle is used to measure the similarity. Combined with the image pyramid search strategy and the indented search step method, the computational complexity is reduced and the robustness is guaranteed.

3.1.1. Filter processing As the first step of production date identification, positioning detection filter processing is needed to reduce the interference of noise on subsequent images. In this paper,
traditional mean filtering, Gaussian filtering, median filtering and block filtering are used to denoise the source image. After comparison of effects, this paper uses median filtering to suppress noise interference.

3.1.2. Create a regional template First, you need to create a standard template image. Since the production date changes with the date, the template feature has feature invariance. Therefore, the year in the production date is selected as the area template library. When the year is updated, only the area template library needs to be replaced. The year date is ok, reducing the amount of work based on template matching. The regional template library used in this paper is shown in Figure 4.

If the multi-angle template is created in the rotating area template library, a false contour will be generated, resulting in a matching failure. Since the region of interest generally does not exist at the edge of the image to be detected, the false contour does not interfere with the matching process, so rotate the image to be recognized to eliminate interference from false contours.

(a) Source image  
(b) false contours

Figure 4. Regional template

3.1.3. Positioning matching process In order to improve the matching precision and reduce the amount of calculation, this paper proposes a method of indenting the angle step to optimize the matching process. On the highest pyramid Y, the image to be detected is rotated by \((0.25 \times 2^Y)\) degrees to create an angle library. The template image is matched, and the optimal angle \(\theta_Y\) is returned according to the NCC algorithm and the coordinate information of the center position is recorded.

On the \(Y-1\) pyramid, take the angular subgraph in the range of \((\theta_Y \pm 0.25 \times 2^{Y-1})\), perform rotation matching every \((0.25 \times 2^{Y-1})\) degrees, return the optimal angle \(\theta^{Y-1}\) and record Center position coordinates. In turn, on the lowest pyramid, a match is made every \(0.5^\circ\) to return the final matching angle \(\theta_1\).

Taking the 5-layer pyramid as an example, the image to be detected needs to be rotated every \(8^\circ\) on the fifth layer pyramid to establish a multi-angle template library, as shown in Fig. 5, returning the optimal angle \(0^5=8^\circ\), on the fourth layer pyramid, rotate the template library every \(4^\circ\) from an angle range of \(4^\circ\) to \(12^\circ\), returning the optimal angle \(\theta_4=4^\circ\), and on the third layer pyramid, take the image to be detected within \(2^\circ\sim6^\circ\) angle every \(2^\circ\) Rotate to build the template library, return the optimal angle \(\theta_3=3^\circ\), and build the angle template library on the second layer pyramid by rotating the image to be detected within \(2^\circ\sim4^\circ\) every \(1^\circ\), returning the optimal angle \(\theta_2=2^\circ\). The image is rotated by \(1.5^\circ\) to \(2.5^\circ\) per \(0.5^\circ\) on the lowest pyramid, and the final matching angle \(\theta_1=2.5^\circ\) is returned, thereby achieving template matching under rotational interference.

Figure 5. Multi-angle template library for 5-layer pyramid images
3.2. Character correction

In the production date defect detection system, the production date character will have a certain inclination, which will bring difficulties for subsequent character segmentation. It must be tilt corrected before segmentation, by calculating the tilt angle of the production date, and then the production date character. The image is rotated to achieve the purpose of proof of production date tilt correction. The calibration results are shown in Figure 6.

![Character correction](image)

(a) Before correction  (b) After correction

**Figure 6. Character correction**

3.3. Character segmentation

In this paper, the vertical projection method and the horizontal projection method are used to divide the binary image of the production date. Before the segmentation, the character needs to be expanded to become a single connected character. The segmentation process and segmentation effect of the character are shown in Fig. 7.

![Character segmentation](image)

(a) Pending character  (b) Inflated character  
(c) Character horizontal projection  (d) Character vertical projection  
(e) Split effect

**Figure 7. Character segmentation**

4. Recognition algorithm implementation

4.1. Character normalization

Since the size of the divided characters is different, in order to facilitate the recognition of characters, the characters need to be normalized to the same size. This paper uses the centroid algorithm to normalize the characters. In general, the ratio of the height to the width of a character is 2:1. By calculating the centroid and divergence of the character, the character is normalized into a character block of 12 pixels wide and 24 pixels high.
4.2. Feature extraction
The purpose of feature extraction is to extract the classification features of characters as the basis for recognition. In this paper, the combination of character grid statistical method and feature projection density method is used as the classification feature. The projection density method obtains $12 + 24 = 36$ dimensional feature vectors in total. The characters are divided into 32 grids, and the pixel values of each grid are counted for a total of 32-dimensional feature vectors. Therefore, the projection density method and the grid statistical method together obtain $36 + 32 = 68$-dimensional feature vectors. The projection feature of the character "1" is shown in Figure 8.

![Character "1" projection](image)

Figure 8. Projection map of characters

4.3. SVM recognition algorithm
In this paper, a total of 650 standard characters are selected, including 500 digital characters, 50 characters, and 100 Chinese characters. The feature vectors are extracted and trained using SVM. In this paper, the radial basis kernel function (RBF) is used as the kernel function of SVM. For a two-classifier combination of one, it is necessary to form three SVM classifiers, namely a character classifier, a letter classifier and a Chinese character classifier. The feature vectors of the characters are tested and matched to the three SVM classifiers by a decision function. Part of the sample set is shown in Figure 9.

![Sample display](image)

Figure 9. Sample display

4.4. Implementation results and analysis
In this paper, 100 milk box photos are selected for testing. The total number of characters is 1200, and the correct number of characters is 1183, and the correct rate is 98.58%. The recognition effect is shown in Figure 10.

![Recognition result](image)

Figure 10 Recognition result
5. Conclusions
Correct identification of production date has a crucial impact on consumers' health and corporate image. Traditional manual identification methods have certain limitations, high cost and low efficiency. This paper uses support vector machine method to make production date. The algorithm for image preprocessing is optimized and improved. The results show that this method is robust to the identification of production date and provides technical and physical support for the smooth implementation of the food and drug recall system.

Acknowledgments
This research work is supported by the Ministry of Science and Technology's innovative methods, project number 2016IM030400, and the title of the project is the innovative method research and application demonstration of the whole chain quality control of dairy safety. This research work is supported by the Ministry of Science and Technology's innovative methods, project number SQ2016IM03640007, and the title of the project is Systematic Application and Demonstration of Intelligent Manufacturing Innovation Method for Agricultural Machinery Equipment

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