Poultry Egg Body Defect Detecting and Sorting System based on Image Processing

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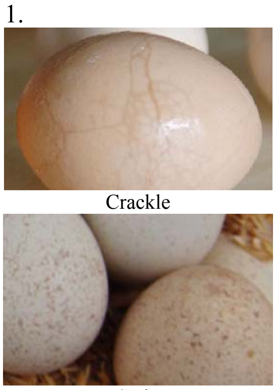
***Abstract* — Currently, egg defect detecting in poultry egg production is mainly manually conducted. In order to improve automatic detecting level, automatic detecting and sorting system on the basis of image processing technology is designed. The system consists of egg transporting and sorting module, texture collecting and processing module and man-machine interaction module. VC++6.0 and OPENCV programming is adopted in the system to extract egg texture information and identify texture characteristics. Design of man-machine interaction module is to realize real-time observation and operation of detecting and sorting process. Texture base of eggs may be automatically generated and texture information may be stored in the system. As a result, through analysis of experimental data, crack identification rate of the system is 97.15, while stain identification rate is 99.3%, and accuracy rate of overall sorting for tested eggs reaches 95%.**

Keywords - poultry egg, texture identification, defect

I. INTRODUCTION

In egg production process, to improve product quality, product sorting has become an essential link. In early times, hand sorting was adopted more, but the labor intensity was high, and efficiency and degree of accuracy was low[1-3]. In order to improve sorting efficiency and automatic level, researchers at home and abroad have done in-depth study, with study direction mainly classified as contact sorting and non-contact sorting. Contact sorting has gradually been replaced by non-contact sorting because of great damage to products. Currently, non-contact sorting methods mainly include non-destructive detection method based on sensor technology and detection method based on machine vision[4-6].

Poultry egg body defects mainly refer to egg body crack and stain. The basis of manual detection lies in visual difference between crack and stain position and other positions on egg body. Egg body defects are shown in following Figure 1.



Crackle

Stain

Figure 1. The egg body defect

Detection based on machine vision refers to that detecting results are output after comparison between analysis results and data in texture base through analysis and processing of egg body image. In the paper, automatic detecting and sorting system for egg body defect is designed on the basis of analysis of advantages and disadvantages of existing automatic sorting technology, based on advanced computer environment and with adoption of image processing technology[7-10].

II. EXPERIMENT DESIGN AND METHODS

A. *Oval process of egg body defect detecting and sorting*

Main processes of egg body defect detecting and sorting include:

Control of texture collecting and processing module, and real-time collecting and processing of poultry egg data;

Control of egg transporting and classifying module, egg transporting and detecting;

Generation of texture database in real time and data storage; as is shown in following Figure 2.

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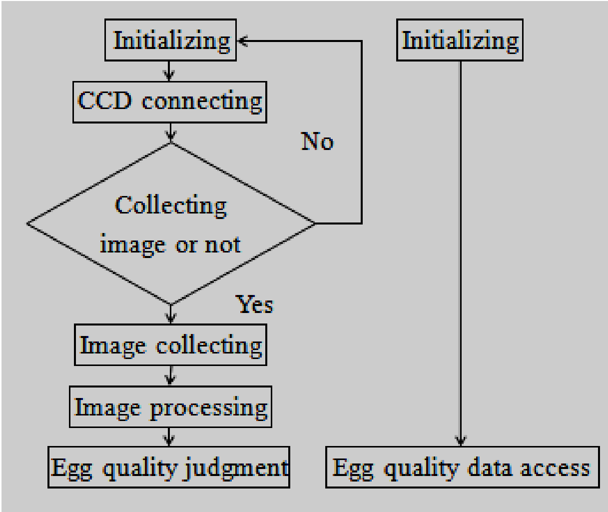
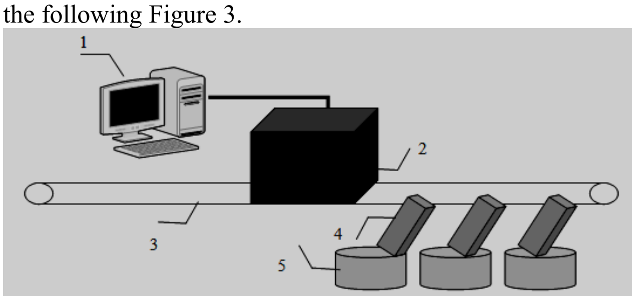


Figure 2. The egg body detection and separation processing

B. *Test Materials and Equipment*

The test was conducted in poultry egg production base, and 120 eggs were randomly selected and then cleaned simply. There were 5 eggs with crack under different degrees upon manual detection; and there were 20 eggs with stain, shape and size of which were different [11-15].

Test device consists of 3 parts, respectively referring to egg conveying and classifying module, texture collecting and processing module as well as man-machine interaction module. Egg transporting and sorting module is composed of 3 parts, including conveying device, egg sorting channel and egg classifying device, realizing egg conveying and classification. Man-machine interaction module may coordinate and control sorting process, and shows real-time sorting information on liquid crystal display, and meanwhile adjusts system settings and checks sorting results etc. Texture collecting and processing module mainly collects and conveys the texture, and processes texture data and outputs sorting results as well. Device structure is shown in the following Figure 3.



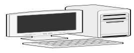
1.computer workstation 2.grain identification device 3.egg conveying device 4.Egg sorting channels 5.Egg classification device

Figure 3. Automatic egg sorting system

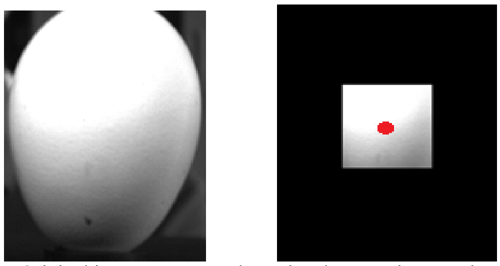
III. KEY TECHNOLOGY FOR EGG BODY DEFECT DETECTION

A. *Intercepting of texture in egg body area*

Before calculation of texture parameters of egg, it requires intercepting texture analysis area in appropriate area on egg body. The captured area must fully reflect texture characteristics of eggs, so captured area could not go beyond boundary of egg body, but the range should not be so small for it may result in loss of key texture information. In such study, a specified-size rectangle was adopted to capture egg body texture, and the center C stayed on the same horizontal line with egg body center. Side length L of the rectangle can be calculated from projected area N of the egg in the image.

 (1)

Where: L-- side length of the rectangle, denoted by pixel value; k($0<k<1$) refers to intercepting coefficient, N denotes captured area on egg surface, and the unit is number of pixel points. Take C as the center of the rectangle, and L as side length of the rectangle to capture texture analysis area on egg body. Such intercepting method is easy for program implementation. It is critical to select intercepting coefficient k. It may meet the requirement for texture analysis provided value of k is taken as 0.1~0.3. Intercepting process is shown in the following Figure 4.



a Original image b Regional texture intercepting

Figure 4. Regional texture intercept

B. *Denoising of texture in egg body area*

After intercepting of texture area, the regional image should be denoised, and central point processing algorithm is adopted in the system. The basic process algorithm is shown in the following Figure 5.

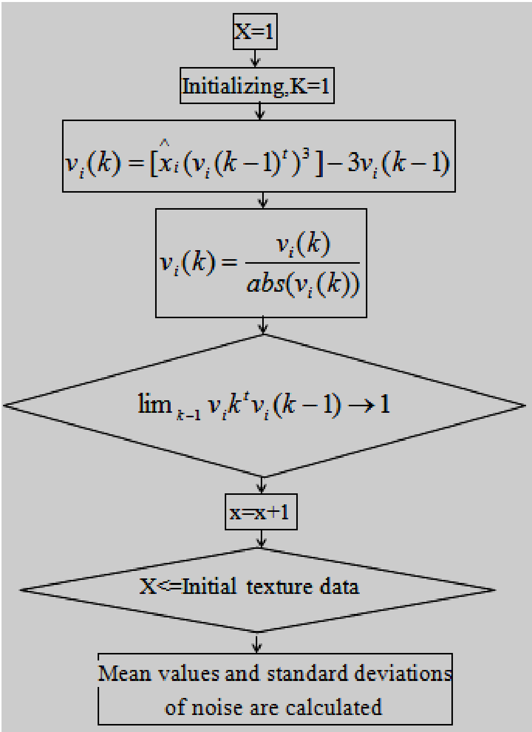


Figure 5. Regional texture processing

With regard to area image after processing, remove the background and seek area edge, and then coordinates of edge in texture area may be obtained. After processing by such algorithm, influence of noise on identification may be greatly reduced.

C. Image processing

With regard to identification of egg body defect, micro texture counting algorithm (LBC) is adopted. Micro texture counting algorithm is proposed on the basis of analysis of micro-structure. Micro texture information may be divided into two types, micro-structure information and gray difference information. Micro-structure information has been widely applied in machine vision algorithm. Nevertheless, it is found in research that dimension, angle and displacement greatly change after real texture image receives influence of change of view and illumination, as shown in the following Figure 6.

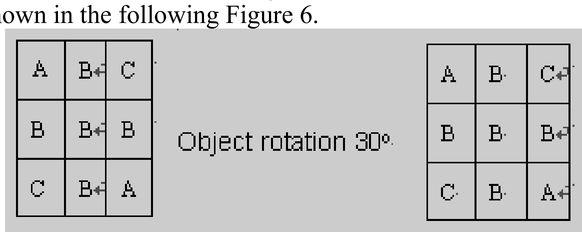


Figure 6. ALBC Algorithm validation

Therefore, texture identification operator must possess rotational invariance. Angle, structure and other information are sensitive to rotation variation, so in order to improve rotational invariance of texture identification, whole micro texture counting algorithm (ALBC) is proposed.

Generally, ALBC operator is divided into three parts: ALBC_SIGN, ALBC_MAGNITUDE and ALBC_CENTER. ALBC_SIGN is just LBC under raw mode, while ALBC_MAGNITUDE is the raw value aiming at gray difference value, and specific computational formula as per LBC approach is shown as follows:

$$ALBC\_M_{P,R}=\sum_{P=0}^{P-1} S(M_P-C) \qquad (2)$$

Where, P, R- pixel value of certain point
M--Min
S--SIFT operator

$$M_P = |G_P - G_C| \qquad (3)$$

Where, GP,Gc --gray value

MP denotes the specific value of micro gray difference, and C denotes a global threshold, the mean value of average micro difference of full image. LBC counts number of pixel about micro gray value beyond center value, while ALBC_MAGNITUDE counts number of pixel point which is relatively greater for gray value through comparison of threshold. ALBC_CENTER reflects the gray value level of central point pixel in the full image, and it is quantified through mean value gray threshold CI:

$$ALBC\_C_{P,R}=S(G_C,C_I) \qquad (4)$$

After respective computation of ALBC_SIGN, ALBC_MAGENITUDE and ALBC_CENTER, count corresponding histogram[14-15], analyze differences among texture characteristics, and make comparison with that in egg defect database, obtaining testing results.

IV. TEST AND DATA ANALYSIS

Divide 120 poultry eggs into 6 batches, and then transmit them to detecting system, and result after comparison between detecting result and manual sorting is shown in the following Figure 7.

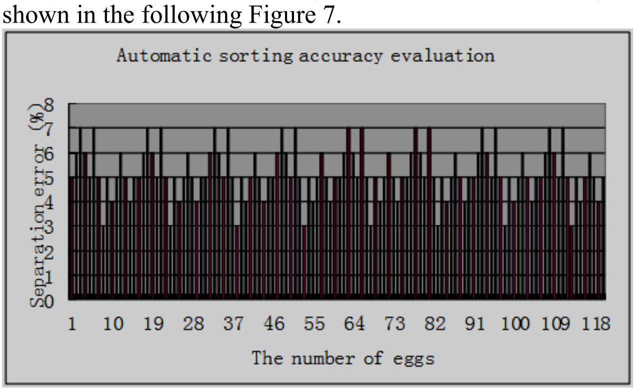


Figure 7. Automatic sorting accuracy evaluation

V. CONCLUSION

(1) Egg body defect detecting method was proposed, and automatic detecting and sorting system which could realize fast and accurate egg classification was studied.

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(2) Test results showed that identification rate of the system on crack and stain reached a high level. Automatic classification system designed in the paper could better meet requirement for egg production.

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