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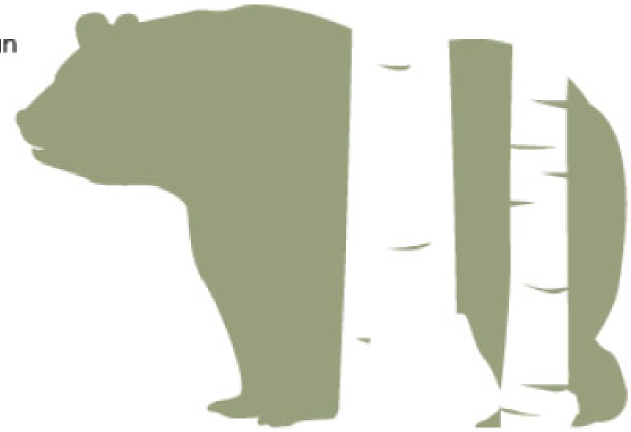

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System Development for Chicken Bone Inspection Using Image Processing

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Abstract: This paper presents system development for chicken bone inspection using image processing. The proposed system consists of conveyer belt, ultraviolet (UV) lamp, webcam camera, electronic circuits, interface card and computer. K-means clustering and thresholding techniques are used for inspection of chicken bone. The image segments are used to calculated area of chicken bone. The experimental results show that the proposed system can inspection of chicken bone.

Keywords: Chicken bone, Bone inspection, Image processing, Non-destructive testing

1. INTRODUCTION

Computer vision and image processing techniques are widely used in food industry and food manufacturing [1-3] such as fishery products, fruit and vegetable products, meat products, seafood products etc. Computer vision and image processing techniques are use to quality evaluation of many food products such as quality inspection of poultry carcasses, quality evaluation of meat cuts, quality measurement of cooked meats, quality evaluation of strawberries, citrus fruits, apples, Quality Evaluation of Pizzas, Quality Evaluation of Corn etc.

Frozen chicken and processed chicken are importance products of Thailand. Many countries import frozen chicken from Thailand. The products are very popular in many countries because they are ingredients for various kinds and cheaper than other kinds of meat. The quality of frozen chicken is based on size, weight and freshness. Major problem in many frozen chicken product is remained have bone in side. Many researchers propose method for bone inspection in frozen chicken [4-8]. Jensen et al. used UV lamp to exposed ultraviolet light about 340 nm and any fluorescent radiation emitted by chicken bone which intensity is proportional to the amount of bones in the frozen chicken [4]. N.J.B. McFarlane et al. presented detection of bone fragments in chicken meat using X-ray backscatter [5]. Seung Chul Yoon et al. presented bone fragment detection in chicken breast fillets using diffuse scattering patterns of back-illuminated structured light [6]. Lino R. Correia et al. presented ultrasonic detection of bone fragment in mechanically deboned chicken breasts [7]. S. C. Yoon et al. presented bone fragment detection in chicken breast fillets using transmittance image enhancement [8]. However the above mentioned system is very expensive. In this paper presents low-cost system for chicken bone inspection using image processing.

2. PROPOSED SYSTEM

The schematic diagram of proposed system for chicken bone inspection using image processing is shown in Fig.1.

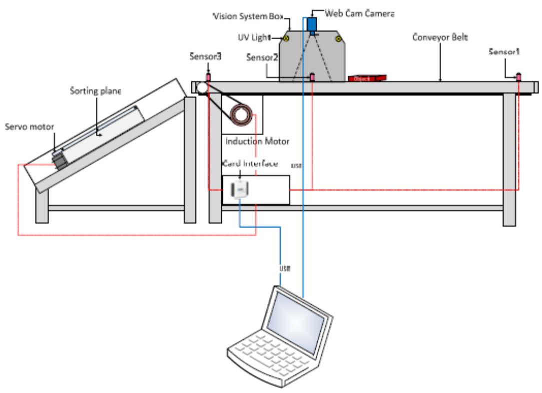

Fig. 1 Schematic diagram of proposed system for chicken bone inspection using image processing.

From Fig. 1, the proposed system consists of conveyer belt, UV lamp, webcam camera, electronic circuits, interface card and computer. Conveyer belt uses for transport chicken to inspection box. UV lamp uses to expose ultraviolet light about 340 nm to chicken sample. Webcam camera employs for image capture. Computer employs for control system and image analysis.

2.1 Image acquisition system.

Image acquisition system is used for image capture and stored. A digital image of chicken is captured and stored in the computer before analysis by proposed algorithm. The image acquisition system consist of :

1. Notebook computer system is used for image stored and image analysis.
2. A webcam camera with 5 megapixels of resolution with USB interface for image capture.
3. Two ultraviolet lamps (UV lamps) radiate ultraviolet light in the range between 315-400 nm.

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SICE Annual Conference 2014
September 9-12, 2014, Sapporo, Japan

4. A wood box where the UV lamps and the camera are placed. The interior walls of the wood box are painted black to minimize background light.

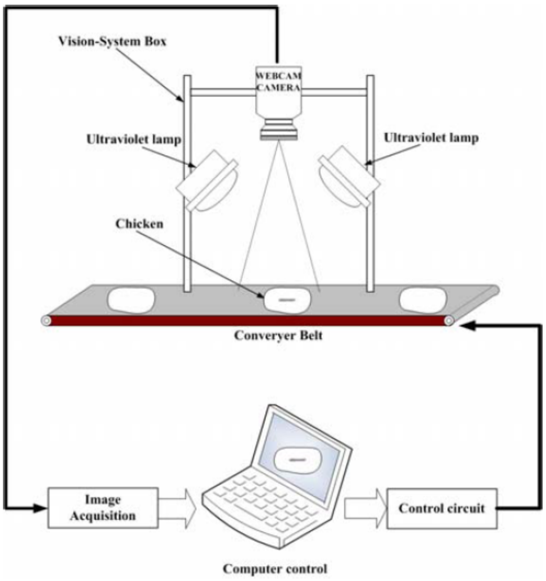

Fig. 2 The schematic diagram of image acquisition system.

2.2 Image analysis.

Chicken image from the image acquisition system is used for bone inspection by image analysis. Image analysis algorithm is separate into two parts as shown in Fig. 3 and Fig. 4.

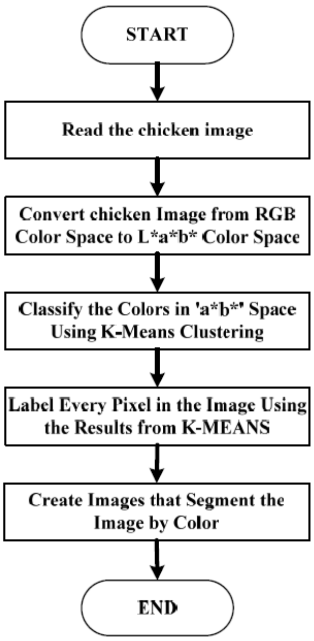

Fig. 3 Algorithm for color segmentation.

Fig. 3 shows image processing algorithm for segmentation of chicken. The algorithm is based on K-means clustering [1],[9-10]. Two classify images were generated by this algorithm. Segmentation of chicken images are chicken flesh and chicken bone.

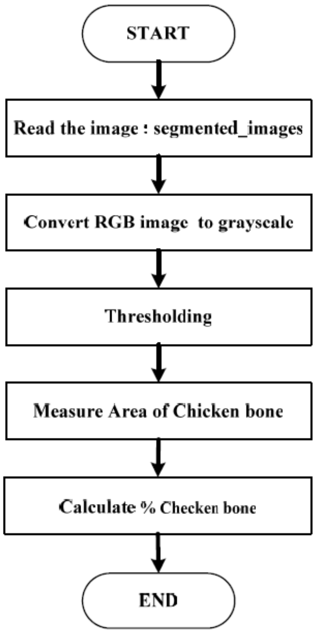

Fig. 4 Algorithm for area calculation of chicken bone.

The segmentation images are used to calculate area of chicken bone by algorithm as shown in Fig. 4. The algorithm is based on thresholding technique [1].

3. EXPERIMENTAL RESULTS

To evaluate the performance of the proposed algorithm for calculate area, rectangular objects with size of 1 to 100 cm^2 was used in experiments. Fig.5 shows rectangular object for use in experiments.

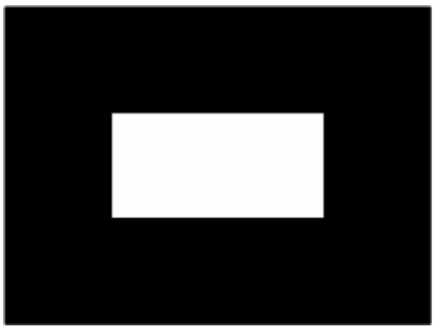

Fig. 5 rectangular object for use in experiments.

We measured the real area of objects and compare with calculable area of the proposed algorithm. Fig. 6 show percent error of calculable area.

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September 9-12, 2014, Sapporo, Japan

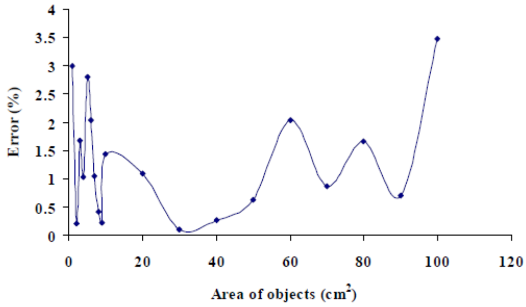

Fig. 6 percent error of rectangular objects with size of 1 to 100 cm^2.

From Fig.6 show maximum error of the proposed algorithm is 3.479 percents. To evaluate the errors from thickness of objects, rectangular objects with thickness of 1 to 5 cm was used in experiments. Fig.7 shows rectangular object for use in experiments.

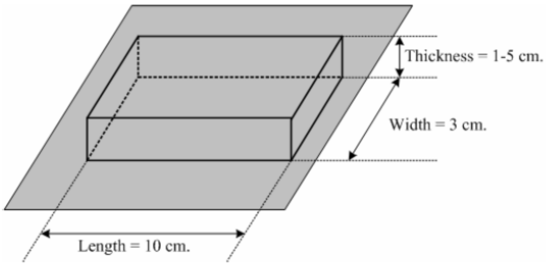

Fig. 7 rectangular object for use in experiments.

We measured the real area of objects and compare with calculable area of the proposed algorithm. Fig. 8 show percent error of calculable area.

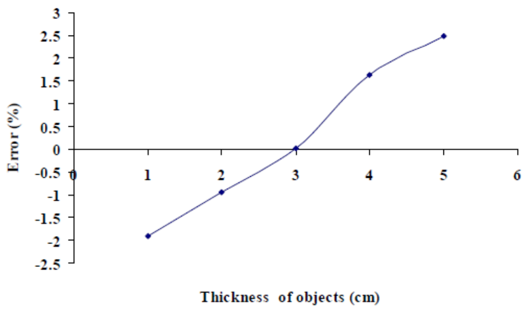

Fig. 8 percent error of rectangular objects with thickness of 1 to 5 cm.

From Fig. 8 show maximum error of the proposed algorithm is 2.484 percents. To verify the performance of the proposed system, chicken with bone are used for experiment. Fig. 9 shows chicken with bone for testing the proposed system.

Fig. 9 Chicken sample for experiments.

Fig. 10 Image of chicken sample after used UV lamp to exposed ultraviolet light.

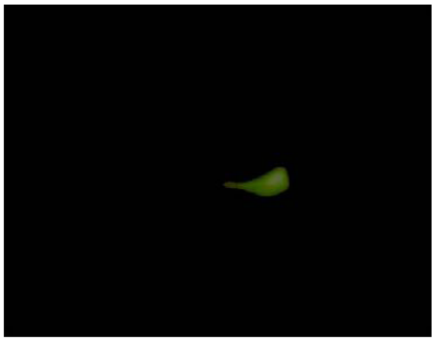

Fig. 11 Segmentation images of chicken bone.

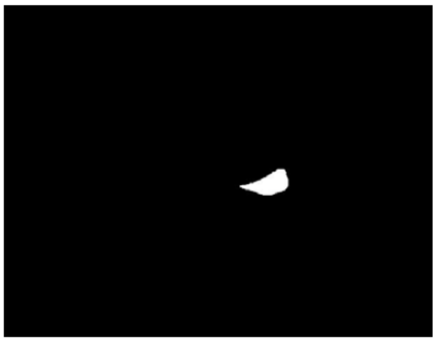

Fig. 12 Segmentation images of chicken bone after thresholding.

SICE Annual Conference 2014
September 9-12, 2014, Sapporo, Japan

The Fig. 10 shows fluorescent radiation emitted by chicken bone. Figs. 11 to 12 show segmentation images of chicken bone and segmentation images of chicken bone after thresholding, respectively. The percentage calculation of chicken bone is about 2.95 percent.

4. CONCLUSION

System development for chicken bone inspection using image processing has been detailed in this paper. Results of some preliminary experiments with chicken sample has been shown performance of the proposed system. In experimental results show that the proposed system can inspection of chicken bone.

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