Ministry of Education and Science of Ukraine

ODESSA NATIONAL ACADEMY OF FOOD TECHNOLOGIES

International Competition of
Student Scientific Works

BLACK SEA SCIENCE 2018

PROCEEDINGS

April, 4, 2018

ODESSA, ONAFT 2018

Ministry of Education and Science of Ukraine

Odessa National Academy of Food Technologies

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DEVELOPMENT OF A GRAPHICAL USER INTERFACE FOR EGG QUALITY ASSESSMENT BASED ON A COMPUTER VISION SYSTEM

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The paper presents a developed graphical user interface for recognizing defective eggs in the MATLAB environment, based on computer vision. The interface is modular, which allows for the upgrade of the procedures and algorithms that are used. The accuracy of recognition for the four main qualitative groups of eggs was tested. Accuracy ranges is from 0.6 to 2.1%.

Introduction

Existing egg sorting systems use different type signs of their classification as color, defects, sizes, etc. In these systems for individual quality indicators are used with separate sensors for their own determination. To determine different types of egg defects is used spectrophotometer system [2, 3]. To determine the size of the eggs are uses computer vision [1].The disadvantage of existing commercial systems is their high cost, complexity and maintenance because of the specific equipment they need for their proper functioning.

The purpose of the article is to develop a graphical interface with procedures and algorithms to determine defective eggs using computer vision, and to evaluate the accuracy of recognition.

Materials and methods

Types of egg defects

When determining the quality of eggs, attention is drawn to six groups quality indicators characterizing the condition of the shell: the shell, air chamber, egg white, egg yolk, germ, taste and smell of eggs. Often the quality of the eggs is determined by osscoping. That's how it can be establish: the state of the protein, the position and the mobility of the yolk, the dimensions of the air chamber, the integrity of the shell and the presence of

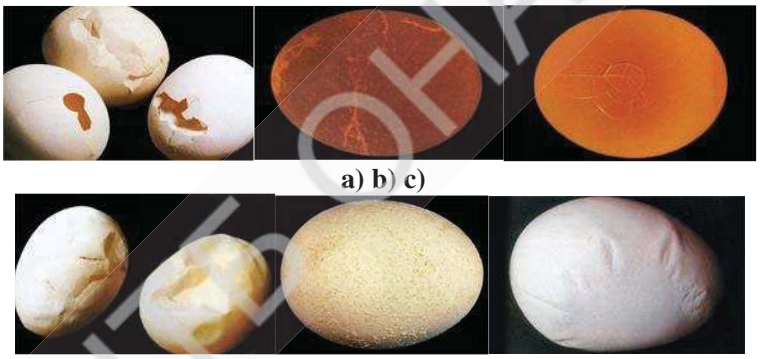
variation in themorphological and construction, presence of defects in eggs, etc.

The shell of all categories of eggs must be of normal texture and thickness, sound, clean and undamaged.

Only eggs may be marketed in the market where the integrity of the shell is not disturbed. Cracked and broken eggs should be used for processing. Attention is also paid to the cleanliness of the shell, since from it to the egg storage is highly dependent. Available for sale only clean or slightly soiled eggs. Heavily contaminated eggs are not subject to sale and storage but must be used for processing.

Common defects in eggs can be the following types:

- rough cracks (Figure 1a) – refers to large cracks and holes that usually lead to a broken membrane of the shell. The incidence of coarse cracks increases with the age of the hen. It varies from 1 to 5% of total production.



a) b) c)

d) e) f)

Fig. 1. Egg defects

- very fine cracks (Figure 1b), generally crossed longitudinally the length of the casing.

- cracks in the shape of a star (Figure 1c) – these are fine cracks, radiating outwards from the central point of impact.

- eggs without shell or very thin shells (Figure 1d) – look unattractive and very vulnerable to disability.

- eggs with coarse shells (Figure 1e) – refer to eggs with roughly shaped areas, often unevenly distributed on the shell.

- flat eggs – when part of the shell is flattened or cut. Often the adjacent part of the shell is wrinkled.

Computer Vision System

Because defects can be assessed visually, it is used computer vision system (Figure 2) to capture the image of the eggs. The system consists of a stand with an egg stand and mounted lighting for illumination of the egg from above and below; PC in which it is being recorded the image captured with a color digital camera. The output image is in RGB color model with 640 x 480 pixels.

Fig. 2. Computer vision system

The main step is to select an informative color component to be used to detect egg defects. For this purpose three more color models were used – Lab, XYZ and HSV.

The software platform was used to develop the interface MATLAB. In Fig. 3. a part of the graphical user interface is presented, which was developed to use to visualize the source image of egg (in RGB pattern), image of egg without background (to be processed only pixels of the egg) and the image of the egg in the three components of each color model.

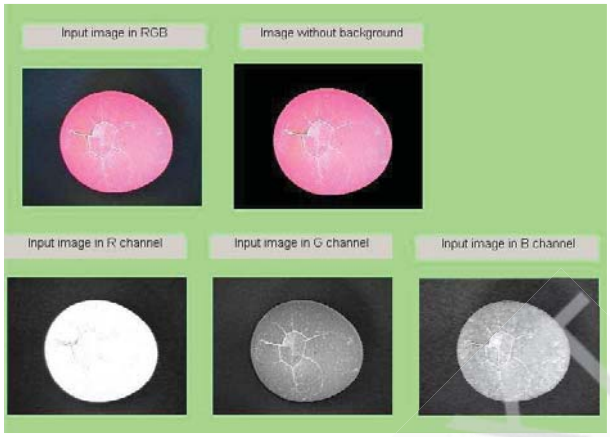


Fig. 3. Graphical user interface for visualizing the output image, background image and the three color model components

The interface also incorporates an opportunity to visualize the histograms of these components (Figure 4).

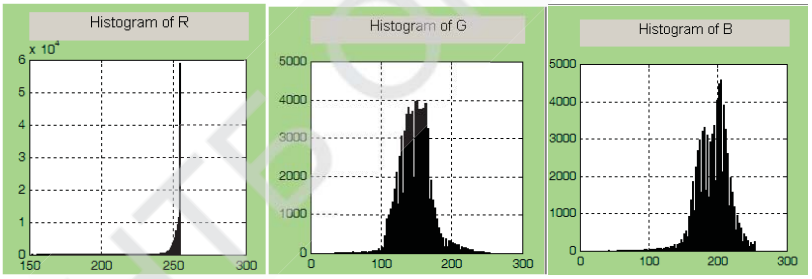


Fig. 4. Histograms of R, G and B components

As an informative, the S component of the HSV color model has been evaluated. The defect recognition algorithm for eggs includes the following basic steps:

1. Convert from RGB to HSV color pattern to the egg output image.
2. Remove the pixels from the image background by setting the limits of the H component.
3. Switch to a black and white image by using a MATLAB built-in function for determining the gray level threshold.
4. Display the contours in the image of the egg.

5. Estimating the egg in one of two possible classes (with or without defects) as a criterion for the absence or presence of defects is the number of contours in the image. If there is one loop – the egg is free of defects, if more than one contour is present – the egg is defective.

This algorithm and the procedures used in its individual steps are embedded in the developed graphical user interface, which is shown in Fig. 5.

The developed graphical user interface has been tested with 120 eggs, 30 pieces of the four classes s, m, l, xl. The test results are presented in table. 1.

Eggs are appreciated by an expert and by the developed interface. The last column of the table shows the error of percentages from the incorrect recognition of the eggs.

a) b)

Fig. 5. Graphical user interface for recognizing egg defects an egg without defects, (b) an egg with defects

Table 1 – Test results of the developed interface.

Egg size	**Expert**		**Developed software**		**Error of percentages from the incorrect recognition of the eggs**	
	With de-fect	Without defect	With de-fect	Without defect	With defect	Without defect
S	13	17	15	15	0,6%	0,6%
M	14	16	16	14	0,6%	0,6%
L	15	15	12	18	0,9%	0,6%
XL	15	15	22	8	2,1%	2,1%

Conclusion

The paper presents a developed graphical user interface for detecting defective eggs in the MATLAB environment, based on computer vision. The interface is modular, which allows for the upgrade of the procedures and algorithms that are used. The accuracy of recognition for the four main qualitative groups of eggs was tested. Accuracy ranges from 0.6 to 2.1%.

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