Evaluation of Insect Damage on Wheat using Image Processing Technology

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Abstract
Image processing technology has been widely used in determination of some properties and quality characteristics of agricultural products. In this study, Rice Weevil (Sitophilus oryzae L.), a pest of stored cereal products, damage on wheat was investigated using image processing technology. The system could separate the damaged wheat automatically and could give the number of them in the sample with high accuracy (90% to 95%).

Key words: Image processing, wheat, insect damage

1. Introduction

1.1. Image Processing Technology
Image processing system involves changing the nature of an image with a computer and suitable software in order to either improve its pictorial information for human interpretation or render it more suitable for autonomous machine perception (McAndrew, 2004). Image processing helps in the accurate, fast, and objective quality determination of important characteristics of food products (Velioğlu et al., 2011). In recent years, image processing technology has become a powerful tool in determining the quality characteristics of agricultural products. It can be used safely throughout the process for determining the quality characteristics of the product without touching or damaging it. Image processing is defined as analysing the image obtained from camera or scanner using proper software and correlate the numeric datas of image with the certain properties of material of interest. Image processing system generally consists of 5 components: Light source, image acquisition device (camera, scanner etc.), signal converter (usually exist in today’s computers), hardware and software. The general methodology used in image processing is as follows; image acquisition, image preprocessing, segmentation, measurement and interpretation.

1.2. Insect Damage on Wheat
Rice weevils (Sitophilus oryzae L.), are generally pests of wheat, oats, rye, barley, rice and corn. Adult females drill a hole into the grain kernel and lay their eggs in the cavity. The hole is plugged with a saplike secretion. Once the eggs hatch, the larvae bore toward the center of the kernel where they feed and pupate (Anon., 2012a).
The adult female rice weevils lays an average of 4 eggs per day and may live for four to five months (producing 250-400 eggs). A single generation can be completed in around 28 days. The eggs hatch in about 3 days. The larvae feed inside the grain kernel for an average of 18 days. The pupal stage lasts an average of 6 days. The new adult will remain in the seed for 3 to 4 days while it’s cuticle hardens and matures (Anon., 2012b).

Detection of rice weevil or its damage on seed conducted by trained human controllers manually using microscope. After the maturation it can be seen easily by naked eye but the time for recovery or protection is out and it causes serious cost and lost of the product. Figure 1a and 1b show the wheat samples damaged by rice weevil.

2. Materials and Method

The whole fine wheat (*Triticum durum* DESF. var. *gedyat*) were collected from local farm in Tekirdag, Turkey. Physical analyses were done by human inspectors using binocular stereozoom microscope (SZ51, Olympus Inc., USA) and by naked eye. As used in the study of Velioglu et al. (2011) image acquisition system consisted of closed box to prevent daylight, 365 nm UV lamps (4x15 W, PL15, Philips Electronics, Netherlands) and camera (NV14HD, Samsung Electronics, UK). The wheats were placed in standard Petri dish and the images were acquired. The images were stored in JPEG format as RGB images. The RGB image is stored in three matrixes, which contain the intensity values of the red (R), green (G) and blue (B) components of image. Image processing was done using Matlab® Image Processing Toolbox. An algorithm was written to indicate, separate and count the insect damaged wheats in whole sample. The algorithm written in Matlab environment classified the wheat according to the pixel intensity values. The results were compared with the results of human inspectors and analyses were done in triplicate.

3. Results and Discussion

According to analyses of human inspectors the healthy and damaged wheat could be determined under binocular stereozoom microscope. After the image acquisition, it was seen that the image of damaged grains had higher intensity values in R matrix than the healthy ones under UV light. The use of certain threshold value provided correct determination of damaged grains in the whole sample. The difference of irradiance among the healthy and insect damaged wheat in which the damaged ones have some brighter areas than the healthy grains could be easily seen on the image by naked eye. Matlab® algorithm could separate the damaged wheat automatically and could give the number of them in the sample with high accuracy (90% to 95%).

4. Conclusion

Some of the applications of computer vision system are inspection, grading and classification of raw materials (i.e. fruits, vegetables and cereal crops) process control of several food treatments (i.e. baking and roasting); quality evaluation of processed foods, and nondestructive analysis of final products in the package. It provides an automated, quick, objective, cost effective, and nondestructive analysis of the samples without the requirement of any trained person (Cakmak & Boyacı, 2011).

Some quality assessments in agricultural production are still conducted by trained human controllers manually and the analysis and results are considered as costly, inconvenient,
boring and doubtful according to the human factor. Needs on objective, consistent and rational measurement results has increased the demand for computerized image processing techniques. In recent years, image processing techniques has been widely used in determination of shape, color, texture and size of agricultural products. Manual measurement techniques has been replaced by image processing according to the advantages such as accurate and consistent results of this novel technique. These systems are flexible in application and they can be used in process lines instead of human inspection.

The present study showed that the images of wheat under UV light can be used in seperation of healty and damaged ones automatically with using suitable algorithm. However there is still need to use different imaging techniques such as multispectral or hyperspectral imaging to reach more accurate results.

Reference list


Figures

FIGURE 1.a. Rice weevil damage on wheat (Anon., 2012), 1.b. (present study)
FIGURE 2. Acquired wheat image

FIGURE 3. Healthy and insect damaged wheat under UV light