Tomato Disease Detection Using Image Processing and Hu Moment Algorithm

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الملخص

الزراعة الدقيقة ضرورية لتحسين الإنتاجية الزراعية لمحصول معين. تعتبر معالجة الصور أداة مهمة لتحديد أمراض النبات ، في حين أن الكشف اليدوي عن مرض الطماطم يعد مهمة صعبة لأنها تتطلب مراقبة جادة

.تسبب هذه الأمراض خطرا على الحيوانات والنباتات وكذلك على الإنسان. يسبب اضطرابات صحية مختلفة مثل مشاكل التنفس وسرطان الجلد وغيرها الكثير في هذا الورقة ، تم تقديم اكتشاف مرض الطماطم في نظام تعريف معالجة الصور اعتمادًا على خوارزمية العزم....

يتكون النظام المقترح من ثلاث خطوات الخطوة الأولى هي المعالجة المسبقة (التحويل إلى صورة مقياس رمادية وعملية العتبة) . تقوم الخطوة الثانية باستخراج ميزات الطماطم الأصلية باستخدام خوارزمية العزم . تنفذ الخطوة الأخيرة تحديد مرض الطماطم باستخدام نسبة المطابقة

Abstract

Precision agriculture is necessary to improve agricultural productivity of specific crop. Image processing is an important tool for identification of plant diseases, whereas manual detection of crop Tomato disease is a difficult task as it takes serious observation. These diseases cause danger to animals and plants as well as to humans. It causes various health disorders like breathing problems, skin cancer and many more. In this paper, Tomato Disease Detection in Image Processing identification system is presented depending on moment algorithm. The proposed system consists of three steps. First step is pre-processing (conversion to gray Scale Image and thresholding operator) Second step performs features extraction of the original Tomato by using Moment algorithm . The last step implements Tomato Disease identification by using matching ratio.

keyword : Precision agriculture , pre-processing , features extraction using Hu moments, matching ratio

Introduction

Libya is famous for agriculture, especially the cities south of Tripoli and north of Benghazi, and this means most of the agriculture industry act as a significant role in the economic sectors. Most of the plants are infected by variant fungal and bacterial diseases. Due to the exponential inclination of population, the climatic conditions also cause the plant disease. An important reason for the decrease in the productive capacity and number of plants is due to their diseases. Agriculture is the primary reason for survival in many

Libyan cities. Because of infection of plants there will be large fatality for growing plants and delivering sufficient food to mankind.
Image processing technology has been and being applied for different applications, agriculture is one of these applications. Image processing is applied for weed detection, for which the plants growing in wrong place in farm which compete with crop for water, light, nutrients and space, causing reduction in yield and effective use of machinery. Weed control was important from agriculture point of view; so many researchers developed various methods based on image processing.[1]
The food and agriculture organization (FAO) ranks tomatoes as the sixth most abundant vegetable around the world [6]. In 2017, nearly 170.8 million tons of tomatoes were produced worldwide [7]. However, the tomato plant is susceptible to many diseases caused by bacteria, viruses, or fungi that have a direct adverse effect on productivity [8].
used digital image processing can get input image using digital camera. Digital camera can get color RGB image and every image is of same size. In this algorithm obtain four color image of infected Disease Tomato ..

2 LITERATURE REVIEW

Rahman, A., Hellicar, A.[2], presented a sequence of image processing and intelligence process used to find the mature grape bunches. The entire process is divided into 2 steps, the grape bunches images are separated from the background image in the first step, wherein the second step the classify the grape bunch based on the mature group, and overall achieved 96% of accuracy.
Vinod Kanan [3] proposed a disease prediction system by using temperature, rainfall, humidity, wind flow soil moisture around the agriculture area and developed a model to predict the diseases. He has summarized the study by concluding the occurrence of disease by analyzing different relationships
among environmental factors.
F. Qin, D. Liu, B. Sun, L. Ruan, Z. Ma and H. Wang.[4] proposed a feasible solution for lesion image segmentation and image recognition of alfalfa leaf disease. The Relief method was first used to extract a total of 129 features, and then an SVM model was trained with the most important features. The results indicated that image recognition of the four alfalfa leaf diseases can be implemented and obtained an average accuracy of 94.74%
Y. Lu, S. Yi, N. Zeng, Y. Liu and Y. Zhang [10]. proposed a novel identification approach for rice diseases based on deep convolutional neural networks. Using a dataset of 500 natural images of diseased and healthy rice leaves and stems, CNNs were trained to identify 10 common rice diseases. The experimental results showed that the proposed model achieved an average accuracy of 95.48%

3 METHODOLOGY

The proposed system as it shown in Fig (1) consists of the steps pre-processing, feature extraction and , identification by using matching ratio

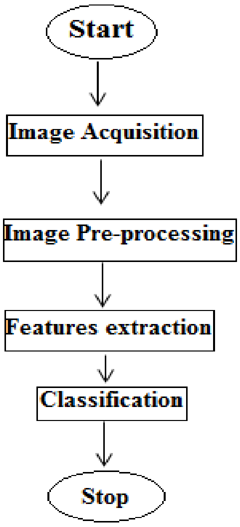

Fig (1) proposed system

3.1 Image Acquisition

The image acquisition stage involves pre-processing, such as scaling. Firstly, the Red, Green and Blue color images are captured using a digital camera with required resolution for good quality .construction of an image database is clearly dependent on the application.

3.2 Image Pre-processing

In this phase two steps are formatted as show in figure 2 :

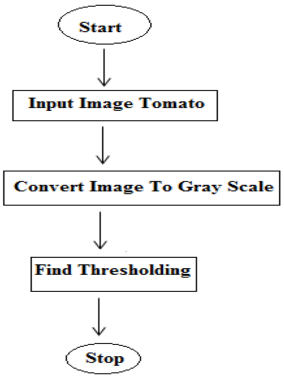

Fig 2 step pre-processing

3.2.1 Gray scale images

Gray scale images only contain brightness information. Compared with binary images, they contain richer information. Typically, gray scale images contain 8 bit data. The range of pixel values is from 0 to 255 and Equation 1 shows the conversion of the image to Gray scale.

$$color = 0.299*Red + 0.5876*Green + 0.114*Blue \quad (1)$$

3.2.2 Thresholding operator

This filter is used to convert image to black (0) and white (255).

The goal is to remove unnecessary information by using specific threshold as

$$\text{Where } B(I,j)= \begin{cases} 255 & \text{if } I(i,j) > T \\ 0 & \text{if } I(i,j) < T \end{cases} \qquad (2)$$

I (i, j) is the gray level of the pixel and T is a specific threshold value Obtaining T automatically .

The algorithm Thresholding are :

1. Select a value of T
2. Segment the image using the obtained T. this will create to groups of pixels. G_1 with all pixels with values <= T, and G_2 with all pixel with values >T.
3. Compute the average U1 and U2 for the two regions G_1 and G_2
4. Compute the new threshold T= 0.5 (U1+U2)
5. repeat steps 2 to 4 until the change in T is smaller than predefined value

3.3 Features extraction Using Moment Algorithm

The mean goal of this process is to come out for features that distinguish one Tomato image to another, so after trying using different parameters and functions, a decision was carried to use general form of a regular moment function m_{pq} of order (p + q) of an image intensity function f (x, y) *that can* be defined in followed paragraph.

3.3.1 Hu moments

It is a 2-D continuous function *f*(*x*,*y*), the moment of order (*p*+*q*) that is calculated using equation (13) as following:

$$m_{pq} = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} x^p\, y^q\, f(x,y)dx,dy \text{ for } p,q = 1,2,3 \dots\dots \qquad (3)$$

The moment sequence m_{pq} completely define the function *f*. These moments are not invariant to translation, rotation and scaling.

- The central moments are defined as

$$u_{pq} = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} (x-\bar{x})^p\,(y-\bar{y})^q\, f(x,y)Dx,Dy \qquad (4)$$

P,q=0,1,2,…………

where $\bar{x} = \frac{m_{10}}{m_{00}}$ and $\bar{y} = \frac{m_{01}}{m_{00}}$

If *f*(*x*,*y*) is a digital image, then

$$u_{pq} = \sum_x \sum_y (x-\bar{x})^p\,(y-\bar{y})^q\, f(x,y)$$

- The central moments of order up to 3 are

$$u_{00} = \sum_x \sum_y (x-\bar{x})^p\,(y-\bar{y})^q\, f(x,y) = \sum_x \sum_y f(x,y) = m_{00} \qquad (5)$$

$$u_{10} = \sum_x \sum_y (x-\bar{x})^1\,(y-\bar{y})^0\, f(x,y) = m_{10} - \frac{m_{10}}{m_{00}}(m_{00}) = 0 \qquad (6)$$

$$u_{01} = \sum_x \sum_y (x - \bar{x})^0 (y - \bar{y})^1 f(x,y) = m_{01} - \frac{m_{01}}{m_{00}} (m_{00}) = 0 \qquad (7)$$

$$u_{11} = \sum_x \sum_y (x - \bar{x})^1 (y - \bar{y})^1 f(x,y) = m_{11} - \frac{m_{10} m_{01}}{m_{00}} (m_{00}) = 0 \qquad (8)$$

- The central moments of order up to 3 are found using equations 9- 14

$$u_{20} = \sum_x \sum_y (x - \bar{x})^2 (y - \bar{y})^0 f(x,y) = m_{20} - \bar{x}\, m_{10} \qquad (9)$$

$$u_{02} = \sum_x \sum_y (x - \bar{x})^2 (y - \bar{y})^1 f(x,y) = m_{02} - y m_{01} \qquad (10)$$

$$u_{21} = \sum_x \sum_y (x - \bar{x})^2 (y - \bar{y})^1 f(x,y) = m_{21} - y m_{20} + 2\bar{x} m_{01} \qquad (11)$$

$$u_{12} = \sum_x \sum_y (x - \bar{x})^1 (y - \bar{y})^2 f(x,y) = m_{12} - 2\bar{y} m_{20} + 2\bar{y} m_{10} \qquad (12)$$

$$u_{30} = \sum_x \sum_y (x - \bar{x})^3 (y - \bar{y})^0 f(x,y) = m_{30} - 3\bar{y} m_{20} + 2\bar{x}^2 m_{10} \qquad (13)$$

$$u_{03} = \sum_x \sum_y (x - \bar{x})^0 (y - \bar{y})^3 f(x,y) = m_{03} - 3\bar{y} m_{02} + 2\bar{y}^2 m_{01} \qquad (14)$$

To normalize the central moments the proposed system uses the following equation**:**

$$where\ y = \frac{p+q}{2} + 1\ for\ p+q = 2,3 \ldots \ldots \ldots \ldots \ldots$$

A seven invariant moments can be derived from the second and third moments using equations 15-21 as following **:**

$$q_1 = n_{20} + n_{02} \qquad (15)$$

$$q_2 = (n_{20} + n_{02})^2 + 4n^2{}_{11} \qquad (16)$$

$$q_3 = (n_{30} + 3n_{12})^2 + (3n_{21} + n_{03})^2 \qquad (17)$$

$$q_4 = (n_{30} + 3n_{12})^2 + (n_{21} + n_{03})^2 \qquad (18)$$

$$q_5 = n_{30} + 3n_{12} + n_{21} + n_{03} \ [(n_{30} + n_{12})^2 - \mathbf{3}\,(n_{21} + n_{03})^2] + + (3n_{21} - n_{03})(n_{21} + n_{03}) \ [\mathbf{3}(n_{30} + 3n_{12})^2 - (n_{21} + n_{03})^2] \qquad (19)$$

$$q_6 = (n_{20} - n_{02}) \ [(n_{30} + 3n_{12})^2 - (n_{21} + n_{03})^2] + 4n_{11} \ (n_{30} + n_{12})\,(n_{21} + n_{03}) \qquad (20)$$

$$q_7 = (3n_{21} - n_{03})(n_{30} + n_{12}) \ [(n_{30} + n_{12})^2 - 3(n_{21} + n_{03})^2] + (3n_{12} - n_{30})\,(n_{21} - n_{03}) \ [3(n_{30} + n_{12})^2 - (n_{21} + n_{03})^2] \qquad (21)$$

3.3.2 Hu's seven moment invariants are invariant to image transformations including scaling, translation and rotation. However, this set of moment invariants is not invariant to contrast changes.

Hu's seven moment invariants have been widely used in pattern recognition, and their performance has been evaluated under various deformation situation including blurring spatial degradations random noise skew and perspective transformations. As Hu's seven moment invariants take every image pixel into account, the computation cost will be much higher than boundary-based invariants. As stated before, image's spatial resolution decides the total amount of pixels, and to reduce the computation cost,

The advantages of traditional moment over other recognition features in shape representation are:

1- Less computationally demanding and easy to implement.
2- Use a single value as the feature, easy for matching.
3- Uniqueness.
4- Invariant to shape translation, rotation and scaling.
5- Less noise-sensitive.

Classification Using Matching Ratio

The flow chart of the system classification is shown in Figure 3.

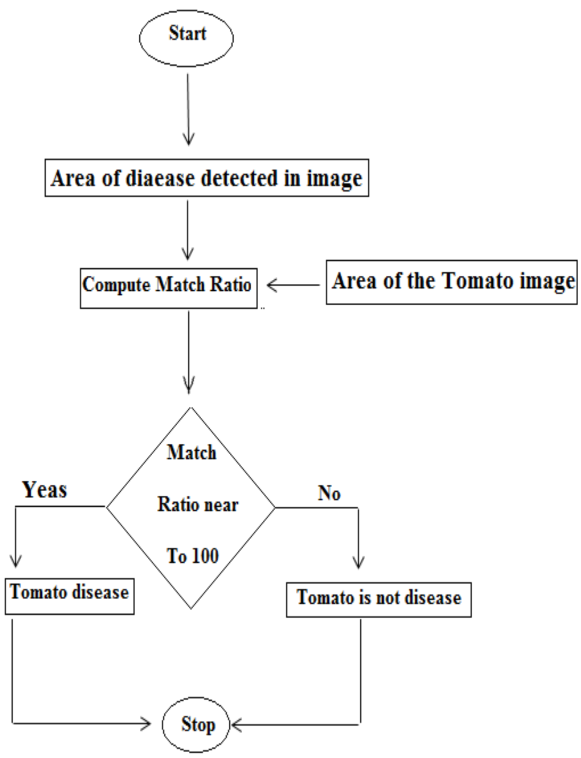

Figure 3. flowchart of the identification Tomato disease

With the help of total area and affected area we can find the total affected area in percentage[9] . For that equation is:

$$\text{Match Ratio} = \frac{\text{area of disease detected in image}}{\text{area of the Tomato image}} \; X \; 100 \qquad (22)$$

4- Results

The window of Image Tomato Authentication system is shown in figure 4

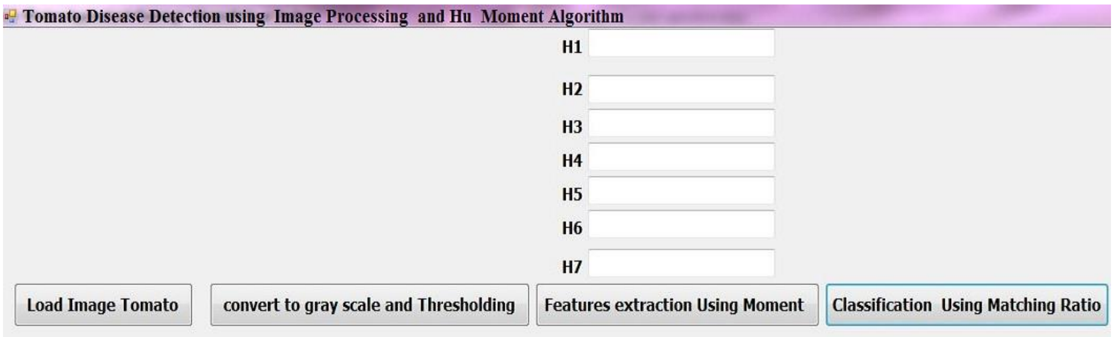

Fig4 The window of Tomato Authentication

The "load" Image Tomato is shown in Figure.(5).

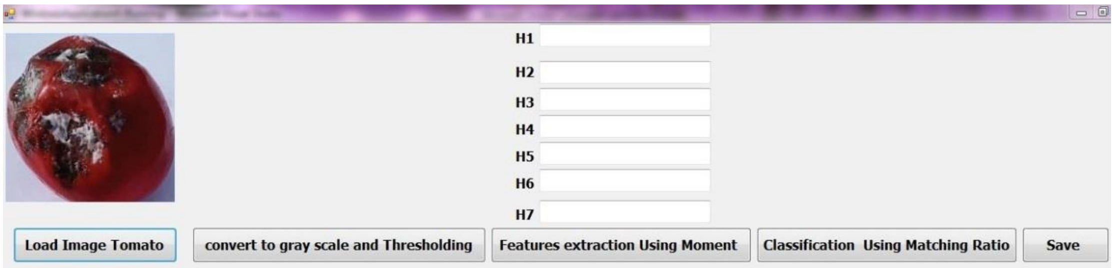

Fig.(5) Load Tomato image.

Thresholding operation is shown in fig.(6).

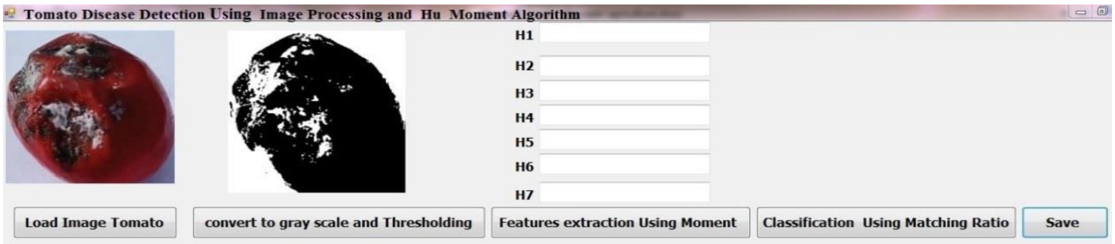

Fig.(6) Convert to gray level and thresholding operation

The moment Operation (feature extraction) is shown in figure.(7).

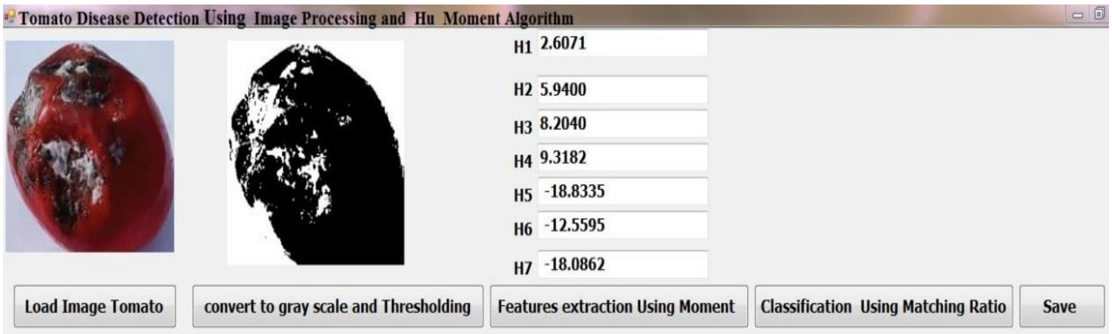

Fig.(7) The Moment Operation (feature extraction)

The matching ratio may be shown as figure.(8):

fig. (8): " Ratio of Matching Between area of disease detected in image and area of tomato image"

5. Software, Hardware :

5.1 Hardware Requirement:

1.Hard disk: 40 GB

2.Ram:512 MB

5.2 Software Requirements:

1.Operating system: Windows 7

2.visual Basic . net 2010

Conclusions

This paper discussed the image processing technique for diseased Tomato plant detection . The average accuracy of the experiment is 80.60 %. Thus image processing technology to measure plant disease severity is convenient and accurate. This eliminates subjectivity of traditional methods and human induced errors. It will helps to farmers to decide the specific quantity for pesticide application which reduces the cost and environmental pollution

FUTURE work :

Future scopes of improvement in present methodologies are :

1-Future work is to be carried out for classification of diseases in different plant species and to developing the classification accuracy.

2- the future, will work on the Support Vector Machine approach to analyze the disease in Tomato

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