

A Philosophical Study of Agricultural Image Processing Techniques

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Abstract

The development of agriculture in China has been substantially aided by the development of image processing technologies. It is simple for people to comprehend the significance of image processing technology for agricultural development by presenting the application status of image processing technology in agriculture and its impact on agricultural production value. This research examines how image processing technology is used in agriculture on the basis of that information. This study first examines how image processing technology is used in the world of agriculture. Second, this study applies both classic machine recognition technology and image processing technology to crop pest identification, analyses their effects, and highlights the application effect of image processing technology in the agricultural industry. The findings indicate that this approach has a recognition rate of 86%, 89%, 91%, 83%, 78%, and 79%, respectively. It is evident that the detection of crop diseases and insect pests is improved by the use of image processing technology.

Keywords: Agriculture, Diseases, insect pests, Image Processing, machine recognition

Abstrak

Perkembangan pertanian di China telah banyak dibantu oleh perkembangan teknologi pemrosesan citra. Sangat mudah bagi orang untuk memahami pentingnya teknologi pengolahan citra untuk pembangunan pertanian dengan menyajikan status penerapan teknologi pengolahan citra di bidang pertanian dan dampaknya terhadap nilai produksi pertanian. Penelitian ini mengkaji bagaimana teknologi pemrosesan citra digunakan dalam pertanian berdasarkan informasi tersebut. Penelitian ini pertama kali mengkaji bagaimana teknologi image processing digunakan dalam dunia pertanian. Kedua, penelitian ini menerapkan teknologi pengenalan mesin klasik dan teknologi pemrosesan gambar untuk identifikasi hama tanaman, menganalisis pengaruhnya, dan menyoroti efek penerapan teknologi pemrosesan gambar dalam industri pertanian. Temuan menunjukkan bahwa pendekatan ini memiliki tingkat pengenalan masing-masing 86%, 89%, 91%, 83%, 78%, dan 79%. Jelas bahwa deteksi penyakit tanaman dan serangga hama ditingkatkan dengan penggunaan teknologi pemrosesan gambar.

Kata kunci: Pertanian, Penyakit, serangga hama, Image Processing, pengenalan mesin

I. Introduction

The first use of digital image processing was in 1920. The time it takes for a photograph to be transferred from the Atlantic side has decreased from more than one week to three hours since the implementation of Batland's cable image transmission system [1-2]. Image processing technology has advanced with the quick development of computers [3–4]. Humans rely heavily on images to exchange and collect information. Every element of human work and life has steadily been impacted by the application of picture analysis and processing. The development of this technology is developing by leaps and bounds, and its application domains are continuously expanding along with the breadth of human activities expanding and the ceaseless appearance of scientific theories, and its great achievements are also accumulating day by day [5-6].

The efficiency of physical labour was historically quite poor, and agricultural growth trends were difficult to manage [7]. According to their work experience, the staff discovered that monitoring the growth of crops can provide them with information about the soil, water, and air humidity, which they can use to improve subsequent work appropriately and ensure that the crops grow normally and produce higher overall output values [8]. As science has advanced quickly, digital image processing technology has become increasingly widely used in agriculture. Examples include the detection of pesticides in vegetables, the control of pests in crops, the identification of crop growth trends, and the colour coding of crops. Digital image processing technology plays an indispensable role [9-10].

For the development of the agricultural field, it is therefore crucial to examine the image processing technology's current state of use. This research paper provides a quick overview of image processing technologies. Four categories of image processing technology methods are covered in this article: image denoising, image rectification, image segmentation, and picture feature extraction. The implementation of image processing technologies in the sphere of agriculture is also examined in this research. Additionally, the impacts of applying standard machine recognition technology and image processing technology to crop pest identification are compared in order to emphasise the application effect of image processing technology in the agricultural industry. The findings of the trial demonstrate how much more effective the image processing-based detection method is.

II. Overview of Image Processing Technology

Image denoising, correction, segmentation, feature extraction, and other techniques are all examples of image processing technology.

A. Image Denoising

Noise is introduced and the image signal is contaminated during the processes of image acquisition and transmission due to the influence of equipment and external variables. Denoising is a well-known and fundamental issue in image processing and analysis. Gaussian white noise and salt-and-pepper noise are two types of typical picture noise.

B. Image Correction

Image skew correction is the process of recovering the image that does not comply with the standard before processing the image. Image skew is primarily caused by the deviation of scanning layout during the process of acquisition. It is highly typical to have diverse image effects during the image acquisition process, particularly the image tilt, due to the varied technology used by each individual. If there is no pertinent tilt correction applied before processing an image with skew, the final automatic recognition will be severely hampered. The image is first examined, and the degree of image skew is determined. Then, to perform the picture rectification, the same angle is rotated in the original coordinate in

accordance with the determined tilt angle. The projection method, nearest neighbour method, Hough transform, Radon transform, and more methods are currently available.

C. Image Segmentation

One of the challenges in image processing and a significant issue in picture analysis is image segmentation. Nevertheless, picture segmentation is the initial stage of the image processing process. The retention and display of image features after segmentation have a significant impact on the subsequent image processing. Image segmentation can be considered to have a direct impact on the outcomes of image analysis and processing, and effective image segmentation will set up the final image processing on a solid foundation. The most well-known and often used segmentation technique is threshold-based segmentation.

D. Image Feature Extraction

The pixel (x, y) in the image is assumed to be integrated throughout the image feature extraction process, and the total of all pixels above the pixel is represented by a sub integration system.

III. Methodology

This research applies image processing technology and classical machine recognition technology to crop pest identification, respectively, and evaluates their results in order to highlight the application effect of image processing technology in the agricultural industry.

A. Subjects

Two crops that were the same size were chosen as the experimental objects in this paper. The two fields' agricultural development patterns were comparable, they were in the same area, and other circumstances were largely the same.

B. Test Object

This investigation's goal is to find crop pests. Pests and illnesses, such as the alfalfa armyworm, blue grey butterfly, bean grey butterfly, flame noctuid, and bean leaf roller, were chosen as the detection items in this study.

C. Detection Index

The detection index in this research is based on the degree of recognition for the two approaches. The detection effect improves with higher recognition degrees.

IV. Results and Discussions

A. Analysis of Image Processing Technology in Agricultural Field

In this paper, the application of image processing technology in agricultural field is analyzed,

Table 1. Application of image processing technology in agriculture

| Application | Function analysis |
|---|--|
| Monitoring crop growth | Accurate judgment of crop growth state |
| Diagnosis of diseases, insect pests and weeds | Ensure the healthy growth of crops |
| Monitoring nutritional status | Replenish water and nutrition in time |
| Monitoring maturity | Improve production efficiency |
| Identify crop colors | Classification of crops |

Agriculture uses image processing technology extensively. The prevalent uses of image processing technology in agriculture are examined in this research. According to Table 1 and Figure 1, the current usage of image processing technology in agriculture focuses mostly on crop growth monitoring, disease

and insect pest diagnosis, nutritional status monitoring, crop maturity monitoring, and crop colour identification. In order to effectively assess the growth state of crops, 29.3% of them are utilised to monitor crop growth.

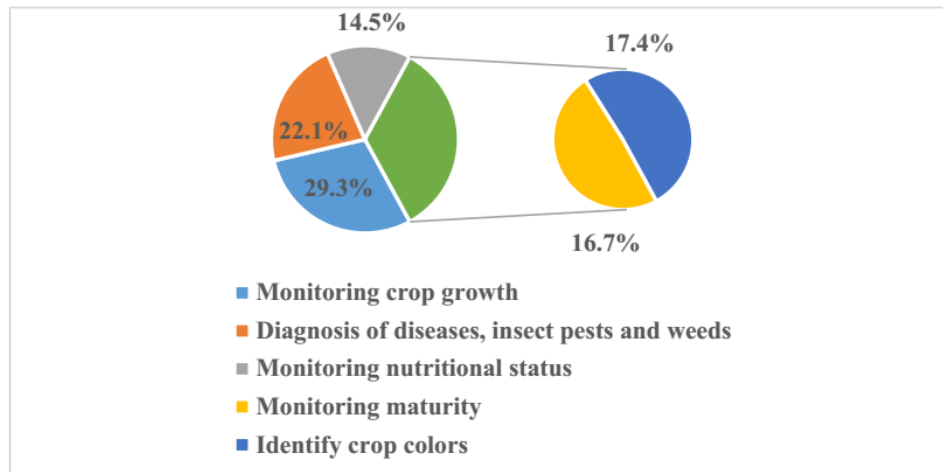


Figure 1. Application of Image Processing Technology in Agriculture

14.5% of cases of illnesses, insect pests, and weeds are diagnosed. It is used to provide crops with additional nourishment and water as needed. 16.7% of applications for crop maturity monitoring are made with the goal of increasing crop production effectiveness. Crop colour identification employed 17.4% of the crop's colour, and its application goal was to categorise crops. This study then goes into further detail about this.

B. Monitoring crop growth

In general, computer vision technology can be utilised extensively during the entire process of plant growth, monitoring plant growth and development, and if abnormal conditions are identified, it is useful to remedy the problem as soon as possible. Crop leaf thickness, rhizome length, and water content are the key monitoring targets, and all pertinent information is meticulously documented. When paired with final data, we can assess crop production comprehensively; when combined with crop fruit photographs, we can determine at any moment whether the fruits are mature, lacking in food and water.

C. Diagnosis of diseases, insect pests and weeds

In addition to giving crops the nutrients they require to grow properly on schedule, it is also essential to deal with the diseases, pests, and weeds that impede crop growth. In the past, this component of work was greatly influenced by agriculture's poor production value. With the development of image processing technology, its use in agricultural work has continued. This liberates the laborious statistical work of crops and significantly reduces the difficulty of staff job. In order for the personnel to carry out preventive work, image processing can be used to forecast potential issues that could arise during the early stages of crop growth.

D. Monitoring nutritional status

Real-time photographs of crop leaves and rhizomes can be captured using image processing technology during the growing process, allowing for the monitoring of crop leaf size and rhizome thickness. Through the monitoring data, crop-related data can be compared to the average state to determine whether there are any nutritional deficiencies or other problems. This allows for the timely

development of an effective remediation plan, which ensures that crops grow normally and receive enough water and nutrition.

E. Monitoring maturity

The crop fruit picture points may be gathered from a wide range using browser image and other relevant analysis technologies, and the crop growth and maturity can be precisely determined by the obtained parameters. These technologies allow us to assess the fruit's maturity and create efficient defences. For instance, the earlier-maturing fruit can be plucked earlier to prevent decay and other decline, which is helpful for the systematic management of the fruit situation and increases the effectiveness of production.

F. Identify crop colors

The visual characteristic of colour makes it simple to assess the quality of crops. Digital imaging technology's gathering and analysis of colour traits transform into a detection method to determine whether the crops are of excellent quality. A theoretical basis was established for the systematic and uniform development of maize quality inspection by using the detection of corn quality as an example. The analysis of multiple image indicators, such as colour saturation and sensitivity of corn kernels, can be used as the quality grading standard of corn kernel sweetness and fineness.

G. Analysis of Image Processing Technology in Agricultural Field

The traditional machine recognition technology and the image processing technology detection method are used to identify crop diseases and insect pests in order to study the application effect of image processing technology in agricultural fields, and the application effect of the two methods is compared.

| Type | Leaf roller moth | Bean leaf borer | Spodoptera exigua | Pseudozizeeria maha | Bean grey Butterfly | Alfalfa armyworm |
|---------------------------------|------------------|-----------------|-------------------|---------------------|---------------------|------------------|
| Image processing techniques | 86% | 89% | 91% | 83% | 78% | 79% |
| Traditional machine recognition | 65% | 71% | 74% | 63% | 64% | 62% |

In this study, six different illnesses and insect pests—the bean leaf roller, bean leaf borer, flame armyworm, blue grey butterfly, bean grey butterfly, and alfalfa armyworm—were chosen as detecting objects. Table 2 and Figure 2 show that there are some discrepancies in the recognition rates of the two distinct detection methods for crop diseases and insect pests.

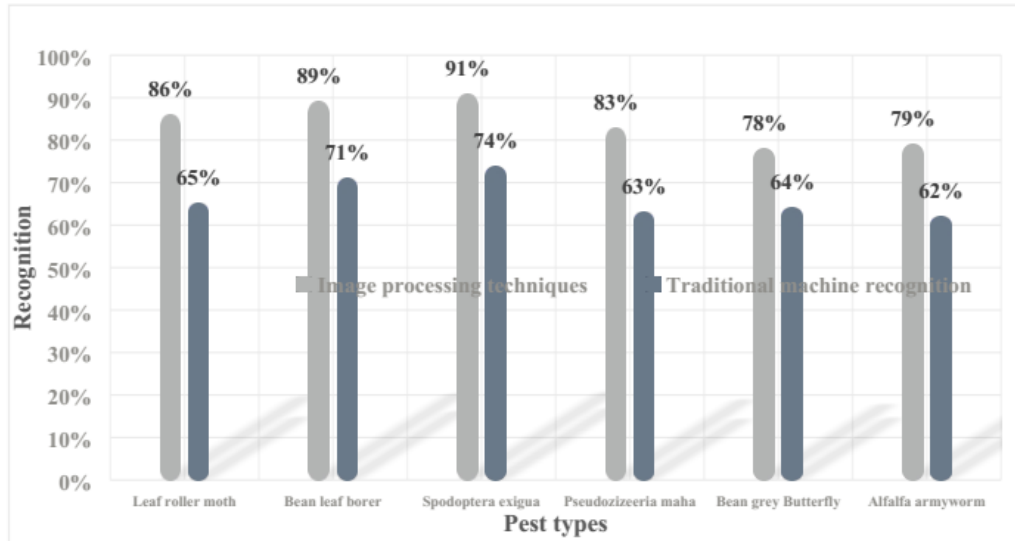


Figure 2. Comparison of different detection methods on crop diseases and insect pests

The classic machine recognition technique among them has a recognition rate of 65%, 71%, 74%, 63%, 64%, and 62%, respectively. Additionally, this approach had a recognition rate of 86%, 89%, 91%, 83%, 78%, and 79%, respectively. The detection approach utilising image processing technology can more successfully detect illnesses and pests based on the recognition data of the two detection methods.

V. Conclusions

In order to achieve the modernization of agriculture level, digital image processing technology is widely applied in all facets of agriculture. Despite a late start, the use of image processing technologies in Chinese agriculture still produced positive outcomes. In this essay, the use of image processing technology in agriculture was examined, and its effects were researched. This study demonstrates how image processing technology is mostly employed in agriculture for the following five purposes: crop growth monitoring, disease and insect pest detection, maturity monitoring, and crop colour identification. Additionally, the use of image processing technology in agriculture has produced positive outcomes, which encourages the growth of agriculture.

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