Emergence of Current Digital Image Processing Applications in Agricultural Domain

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Abstract

Digital Image Processing manifested to be a powerful tool for successful analysis in different areas and fields. Image processing with easy accessibility of corresponding system may alter the circumstance of gaining the advice of expert and at average cost since digital image-processing is the viable tool for examination of variables. Nowadays, computers are being utilized for automation, mechanization, expert system, Remote Sensing, Geographic Information systems and to develop a decision support system for taking vital choices on the protection research and agricultural production. This paper concentrate on the study of the importance and applications of Digital Image Processing in an agricultural area like Identification of Nutrient inadequacies and plant content, Fruits quality grading, sorting and inspection, Object tracking, land and crop management. The study presents a concise study of some of the current Digital Image Processing applications in the agricultural domain. The research findings indicate that from 2016 to 2024, the global 3D imaging market is expected to hit $26 billion, expanding at a CAGR of 23.7 per cent in global smart agriculture.

Keywords

Digital Image Processing, Remote Sensing, Crop Management, Hyperspectral Imaging, Agriculture

1. Introduction

Agriculture is a significant part of an economy that gives essential needs and nourishment for people. Advances in the area of innovation and science made another revolution in the agricultural segment. The job of information technology has expanded the potential of the agricultural segment by utilizing the automated system in different exercises [1]. New advancements like precision agriculture [2], GPS, sensor systems, robotics have risen with ongoing developments and advancements in the agriculture segment. Digital Image Processing, Machine Vision and Computer Vision are different procedures utilized in the advancement of an automated system to serve their different purposes. In the application of agriculture science, for example, digital image processing, distributed and parallel computing decreases the computational time and thus, plant acknowledgement can be made a lot quicker [3].

India is a cultivating country; wherein about 70 per cent of the populace depends upon farming [4]. For high yield and quality, farmers choose suitable fruits and vegetable crops from a wide range of crops. The cultivation of these crops requires highly sophisticated techniques for specialization [5]. Computer use among agriculturists and other farming experts has risen quickly previously and future ramification for agricultural software decade [6]. Image analysis is a powerful tool for the nondestructive investigation of agricultural items, which is generally utilized in agribusiness [7]. Images have contributed herein development in digital images taking gadgets, programming or software to work on. The foremost benefit of digital image analysis is its capacity for objective and nondestructive analysis [8]. There are tools that may either not only process clear images or also on

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dark images to humans like Infrared (IR), ultraviolet (UV) and Near Infrared (NIR). An image is a two-dimensional representation of a constrained set of digital values is named a digital image. An image is a 2-D function, f (x, y), where x and y speak to spatial coordinates, and the adequacy of 'f' at any pair of coordinates (x, y) is known as the grey or intensity level of a given image at that point [9].

1. Phases of Digital Image Processing

DIP method several tasks, such as image acquiring, preprocessing of images, segmentation of images, extraction of features and classification. The steps are explained as follows in Fig. 1 [10]:

Image Acquisition/Dataset: The first involves the acquisition of better qualitative images for achieving high accuracy as a suitable dataset is required for object recognition at every level.

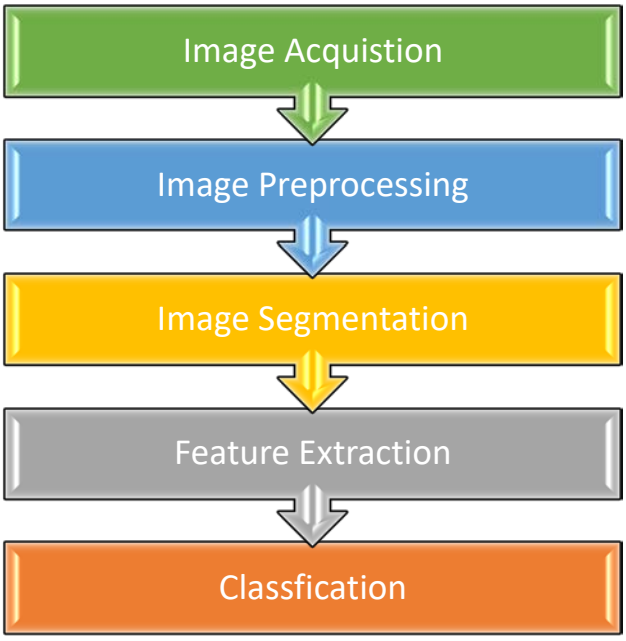

Figure 1 Phases of Digital Image Processing

Image Preprocessing: Preprocessing of images usually includes eliminating background noise, normalizing the intensity of individual pixels and eliminating reflections. Preprocessing basically enhance the images.

Image Segmentation: Segmentation divides image into various sections with solid relationship between the objects of interest. The outcome of image segmentation gives set of portions that jointly cover the whole image.

Feature Extraction: In this phase the essential features of region of interest of segmented images will be extracted and recognized based on color, texture and shape features.

Classification: In this final phase, data will be trained and tested.

2. Digital Image Processing based Applications in Agriculture

Significance and effect of Image processing in society can be decided by its applications in various fields like aerial and satellite imaging, industrial inspection, medical imaging, defense applications, law enforcement and agriculture sector [1]. Various applications of image processing in agriculture area are discussed in this section (Fig: 2).

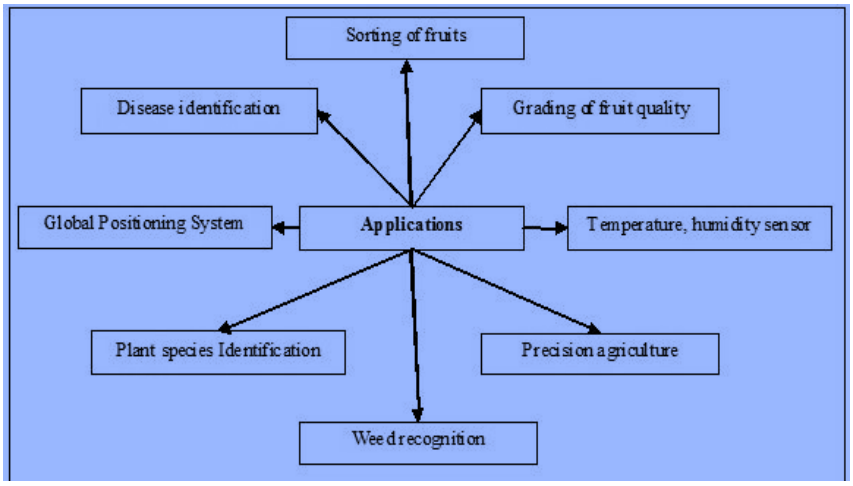

Figure2 Digital Images Processing based Applications in Agriculture

Digital Image Processing in agricultural applications serves following purposes [11]

1. For recognition of diseased leaf, fruit as well as stem.
2. For thoroughly checking disease prone area.
3. For obtaining the shape of affected area through disease.
4. For obtaining the color of disease affected area.
5. For finding outsize, variety and shape.

3.1Application areas of Digital Image processing in agricultural field:

Nutrient inadequacies identification and plant content, Grading quality of fruits, sorting fruits and inspection, Object tracking, realm and crop estimation, Crop Management.

A) Identification of Nutrient inadequacies and plant content:

The lack of large scale (K, N, P, S, Ca and Mg) and small scale (Fe, Mo, Cl, Cu, B, and Zn) minerals majorly affects plant advancement. Minerals majorly affect plant advancement [12]. The absence of some supplement minerals particularly of phosphorus, calcium, iron, and nitrogen is a gigantic issue for agriculture and early warning and avoidance of the issue will be helpful for agro-industry. Techniques as of now used to decide nutritional deficiency in plants, plant tissue analysis or consolidated strategies. Yet, these techniques are moderate and costly.

B) Fruits quality grading, sorting and inspection:

Agriculture items are reviewed dependent on their measurements and quality. This evaluation is utilized to sort them and appoint them to various sales channels. Everything may yield better pay based when appropriately dispensed by its accurate attributes. Normally, higher evaluation and greater farming items produce bigger incomes [13]. Conventional evaluating was human dependent. Afterwards, mechanical gadgets were utilized to separate agrarian items dependent on their measurements and weight. Classification of fruits and vegetables using feature extraction and classification models with the different combinations are being utilized.

C) Object tracking, land and crop estimation:

Here in this study [14] Crop of Tobacco territory and yield estimates are significant in balancing out tobacco costs at the sale floors. The yield of tobacco estimation in Zimbabwe is presently founded on ground-based and statistical surveys. These strategies are expensive, tedious, and are inclined to huge mistakes. Remote detecting can give auspicious data on crop spectral qualities which can be utilized to appraise crop yields.

D) Crop Management:

Here in this for crop assessment using remote sensing weed detection is used, using pest management detection of insect has finished and for irrigation also used wireless sensor network. Phadikar, S., Sil, J. [15] the paper portrays a product model framework for disease detection of rice

dependent on the contaminated images of different plants of rice. Piyush Chaudhary et al. [16] proposed an algorithm for sickness spot division utilizing the DIP technique in plant leaf. Yunseop Kim et al. [17] proposed an algorithm for "wireless sensor networks, software for real-time in-field sensing details of the instrumentation, software for real-time in-field sensing and design of variable rate irrigation, and control of a site-specific precision linear-move irrigation system". Kamal N. Agrawal et al. [18] proposed the weed identification procedure utilizing an image processing system.

3.2 Applications based on Imaging Techniques

The Source of radiation in image processing was significant and the sources were X-ray imaging, UV band imaging, visible band imaging [19], imaging in Gamma-ray and IR band, Microwave band and Radio band imaging. The remote Sensing (RS) procedure was generally utilized for different applications in agriculture. Remote Sensing was the study of recognizable proof of earth surface highlights and estimation of geo-biophysical properties utilizing electromagnetic radiation. In image processing source of radiation was significant and the sources were X-beam imaging, imaging in the UV band, imaging in the Microwave band, Gamma beam imaging, imaging in the obvious band and IR band, and imaging in the Radio band. Thermal imaging which was a latent system (infrared lies between 3 to 14 μm) centers around Water. X-ray imaging for baggage inspection of stash nourishment items.

3. Importance of Digital Image Processing in Agriculture:

- **Visualization:** Observe the items that are not imperceptible
- **Image Restore and Sharpen:** To build up a better image
- **Estimation of Pattern:** To estimate the several objects in image
- **Image Recognition:** Recognize the objects in a picture.
- **Image Retrieving:**Find ROI in an image.

4. Size and Prediction of the Global Smart Agriculture Sector, 2016-2024

Agricultural sectors where the variables like quality, the canopy of the item are the important measures for the farmers. Most of the time advice of experts may not be reasonable and expert's accessibility, as well as their administrations, may absorb time [20]. Image processing with easy accessibility of corresponding system may alter the circumstance of gaining the advice of expert and at average cost. During the present study it is evident that from 2016 to 2024, the global 3D imaging market is expected to hit $26 billion, expanding at a CAGR of 23.7 per cent (Figure: 3).

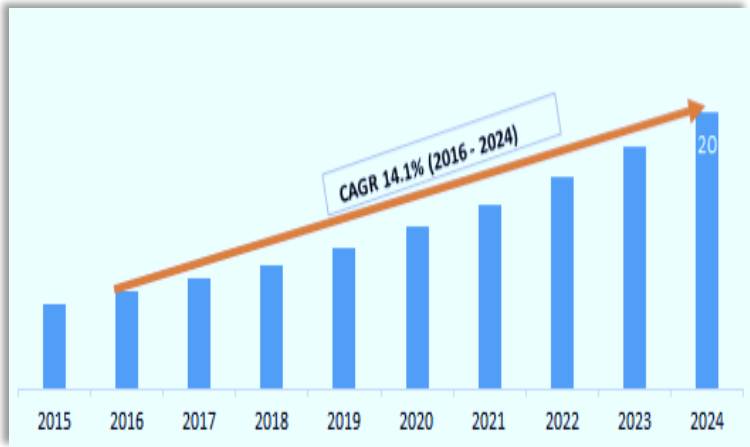

Figure3 Predictive Trends in Global Smart Agriculture

5. Conclusion

Digital Image Processing technique manifested as a successful Computer Vision framework for an agricultural area. Different applications of image processing have been talked about in detail imaging strategies with various ranges, these techniques are steady being developed for computerization models and acquiring higher precision of data. For example, Remote Detecting, Hyper Spectral Infrared Imaging help decide the vegetation records, cover estimation and so forth with more accuracy. Weed classification influences the capitulate (yield)can be effectively categorized with the algorithms of digital image processing. The classification accuracy ranges from 85%- 96% relying upon the limitations and algorithms of image acquisition. So, with these farmers can pertain herbicides in the right structure. The proposed methodology renders help in protecting the environmental factors. Hence, it can be conclude that Digital Image-Processing is an effective tool and a noninvasive method that can be related to the agricultural space with incredible accuracy for examination of different agronomic variables.

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