Plant Disease Identification Using the Unmanned Aerial Vehicle Images

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Abstract: Important factors in plant development and the elimination of both qualitative and quantitative declines in crop yield are early and effective identification and evaluation of plant illnesses. Optical techniques such as RGB imaging, multi- and hyperspectral sensors, thermography, or chlorophyll fluorescence have shown their ability for early outbreak detection and quantification of plant diseases in automated, objective, and reproducible detection systems. Recently, as an optical inspection that offers additional information on crop plant vitality, 3D scanning has also been introduced. Different platforms from proximal to remote sensing are available for multiscale monitoring of single crop organs or entire fields. Accurate and accurate disease detection is enabled by highly sophisticated and advanced data analysis methods that lead to new sensor data insights for complex plant-pathogen systems.Non-destructive, sensor-based techniques help and extend the detection of plant diseases through visual and/or molecular approaches. Precision agriculture and plant phenotyping are the most important fields of use of sensor-based analyses. We suggest UAV base imaging for plant disease detection in this article.

1. Introduction

The forecast of significant obstacles to crop production, such as the impact of climate change, pathogens and pests, has become a crucial problem for food management strategies in recent years. In addition, certain methods and strategies for tracking the state of plants as well as the quality and quantity of agricultural products have been introduced owing to population growth and the volatility of agricultural production due to climate change.

The inspection process for the early diagnosis of illnesses is evidently highly time-consuming. It is also important to find a method of detection that would be quicker than expert field inspection. The shortcomings of direct field inspection approaches have driven researchers to explore remote sensing data in order to collect information on plant health easily and inexpensively. Non-destructive remote sensing data allows measurements of plant biophysical and biochemical parameters for non-destructive plant growth and health monitoring.

2. Literature survey

The authors developed an online microclimate monitoring and control framework for greenhouses by using a wireless sensor network. In a greenhouse in Punjab, India, they field-tested the device, testing its measuring capability and network efficiency in real time.[1]

With specific focus on the programming aspects and the testing of a temperature and humidity sensor, an integrated wireless greenhouse climate monitoring system has been detailed. There are three modules in the proposed system: The Sensor Station (SS), the Controller Station (CS) and the Central Control Station (CCS).[2]

The use of the Internet of Things (IoT) and data analytics (DA) is used to increase the agricultural sector's organisational performance and productivity. There is a paradigm change from the use of Wireless Sensor Networks (WSN) to the use of IoT and DA as a big engine of smart agriculture. Several latest innovations, such as WSN, radio frequency recognition, cloud computing, middleware platforms, and end user applications, are built into the IoT.[3]

To estimate the grassland biomass (kg dry matter / ha / day) of two intensively controlled grassland farms in Ireland, multiple linear regression (MLR), artificial neural network (ANN) and adaptive neuro-fuzzy inference method (ANFIS) models were developed.[4]

In this article, we suggest a distributed Bayesian localization algorithm based on message forwarding to solve the estimated inference problem based on obtained signal intensity indication. The algorithm is intended for precision farming applications, such as pest management and pH detection in large farms, where greater power efficiency is needed in addition to communication and computational scalability, but criteria for position accuracy are less demanding [5]

3. Proposed system

The key stage in the identification of UAV-based plant disease is called radiometric calibration, and measurements of reference points are carried out in observational line-based methods. The feasibility and necessity of the radiometric calibration stage is then explored in the identification of plant disease using UAV-based multispectral pictures.

Precision cultivation and plant phenotyping are fields focused on knowledge and technologies with unique demands and obstacles for plant disease diagnosis and detection. Precision agriculture is a method of crop management focused on the spatial and temporal variations within a region of crop and soil variables. In order to promote a management decision, this method attempts to achieve real-time, comprehensive mapping structures for crop, soil, and environmental variables.

In the opposite, conventional agricultural management methods presume that criteria in crop fields are homogeneous, leading to the application of pesticides and the control of crop protection that is not specifically connected to the current situation of disease control. In view of the fact that the incidence of plant disease depends on particular environmental conditions and that diseases often display a heterogeneous spread in fields, optical sensing techniques are useful in the detection of focal areas of primary disease and areas that vary in field intensity of disease. In tandem with sophisticated data processing approaches, these techniques can be used in sustainable crop production for tailored pest control programmes. According to precision crop management techniques, site-specific and selective applications of pesticides result in a possible decrease in the usage of pesticides which will therefore minimise the economic costs and ecological effects of agricultural crop production systems.

4. Result and discussion

Whereas precision agriculture seeks to analyse spatial heterogeneities within crop stands, under distinct environmental conditions, plant phenotyping assesses the appearance and efficiency of a genotype. A large variety of different genotypes are evaluated for disease and abiotic stress tolerance, yield , quality of development, and several secondary traits during the plant breeding process. Host pathogen associations and the vulnerability of the breeding material must be tested effectively in disease resistance breeding. The target plant content must be evaluated in an exhaustive and time consuming way by genotyping and phenotyping. These studies require several steps: tests in diverse habitats, under regulated and natural field conditions, as well as on specific plants, individual organs, and even whole field canopies.Plant phenotyping, in particular, is labour-consuming and time-consuming and is very expensive as well. Phenotyping has recently been used as a synonym for non-invasive imaging and sensor-based study of the properties of structural, physiological , and biochemical plants.

In terms of plant disease identification, both precision agriculture and plant phenotyping have unique needs and difficulties. New methods must be adopted and integrated into existing testing and evaluation systems in order to achieve realistic and accurate automatic diagnosis and identification of plant diseases. As in Figure 1, UAVs are promising instruments for the identification and diagnosis of non-invasive diseases

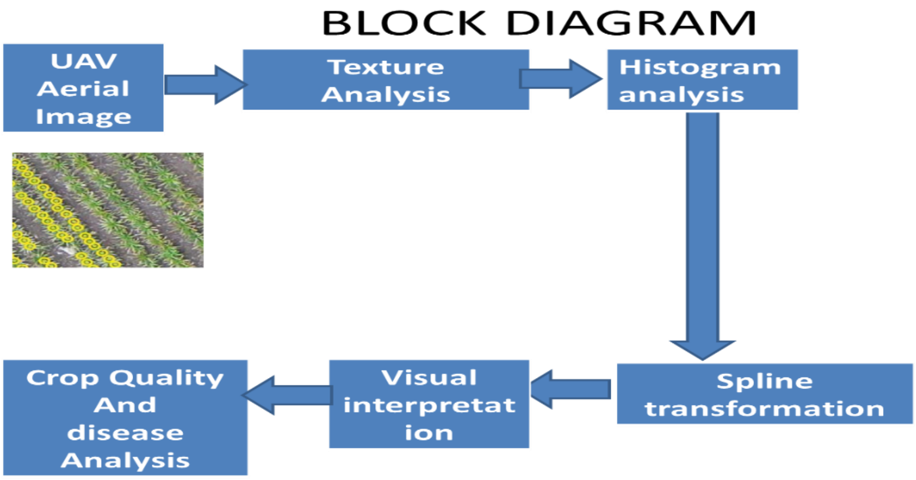
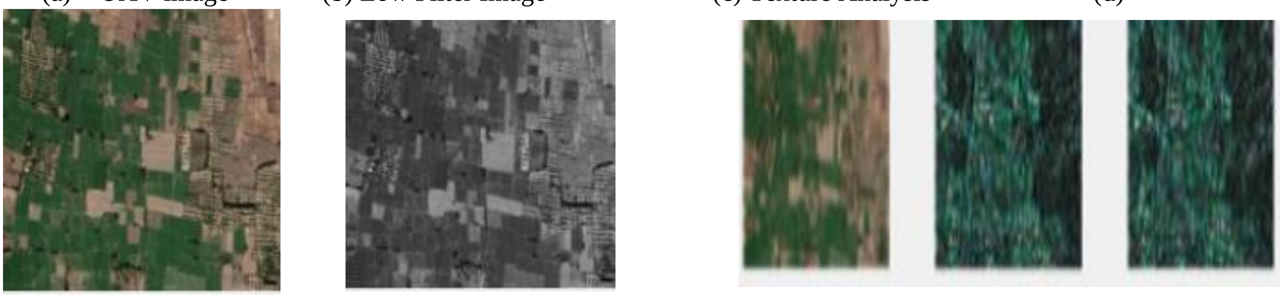


Figure 1: Block diagram for the proposed UAV image for plant diseases

A rising range of imaging and non-invasive devices are available that can enable diagnosis and the identification of plant diseases. Along with the extension of geographic information systems, the development in sensor and information technology opens up new possibilities for precision agriculture and plant phenotyping. Figure 2 illustrates UAV image processing according to the recognition technique for plant diseases.

(a) UAV image (b) Low Filter Image (c) Texture Analysis (d)



Histogram of Texture image (e) Spline processed Image

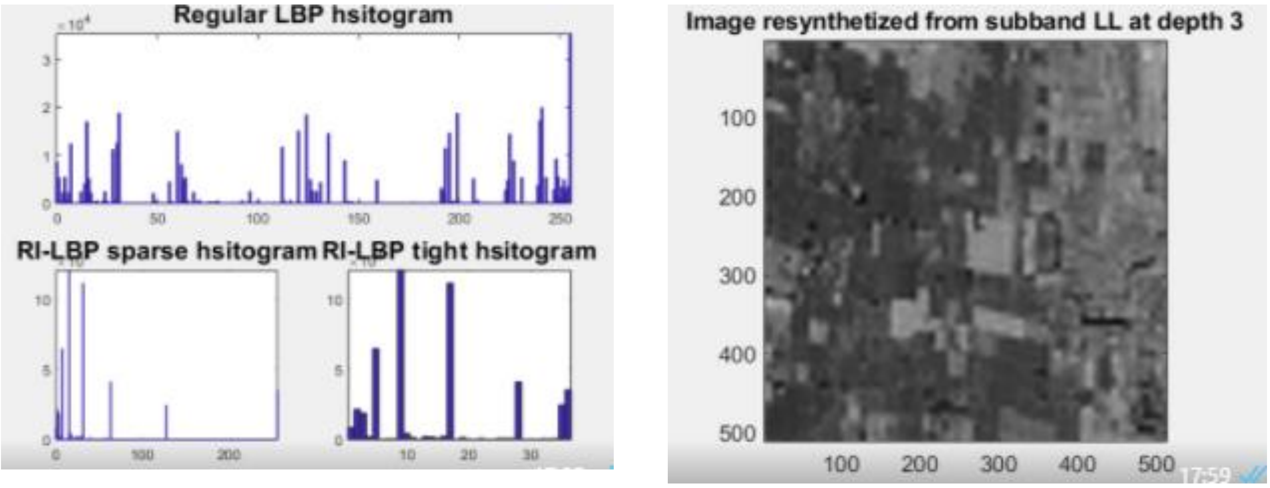


Figure 2*:* UAV image processing as per the methodology for plant diseases identification

5. Conclusion

Cantered on aerial multi-spectral photographs, this paper focused on the need for radiometric calibration to identify diseased trees in orchards. Two research sites where multispectral images were obtained using a multirotor UAV were chosen for this purpose. The effect of radiometric correction on the diagnosis of plant diseases was measured by comparing the separability of the stable and diseased groups. The negligible effect of radiometric calibration on separability parameters was shown by the experimental findings. Radiometric calibration is known as the first stage in the identification of UAV-based plant diseases, and observational line-based approaches are used to calculate reference targets. The feasibility and necessity of the radiometric calibration stage is therefore explored in the identification of plant diseases using UAV-based multispectral pictures.

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