Chapter 26
Computational Intelligence for Pathological Issues in Precision Agriculture

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ABSTRACT

Plant Pathology is the scientific study of plant diseases, caused by pathogens and environmental conditions (physiological factors). Detection and grading of plant diseases by machine vision is an essential research topic as it may prove useful in monitoring large fields of crops. This can be of great benefit to those users, who have little or no information about the crop they are growing. Also, in some developing countries, farmers may have to go long distances to contact experts to dig up information which is expensive and time consuming. Therefore, looking for a fast, automatic, less expensive, and accurate method to detect plant diseases is of great realistic significance. Such an efficient system can be modeled by integrating the various tools/techniques of information and communication technology (ICT) in agriculture. The objective of the present chapter is to model an intelligent decision support system for detection and grading of plant diseases which encompasses image processing techniques and soft computing/machine learning techniques.

INTRODUCTION

The sole area that serves the food needs of the entire human race is the Agriculture sector. Agriculture is the set of activities that transforms the environment for the production of plants for human use. Research in agriculture is aimed at improving production techniques, agricultural productivity in terms of quantity & quality, transformation of primary products into end-consumer products and prevention and correction of adverse.

This chapter aims to address some issues of disease management in plants. Further, provides an insight into how the various techniques of image processing and computational intelligence can be effectively deployed in the precision agriculture. The chapter begins with an introduction to plant pathology and precision agriculture followed by design of the system, implementation, analysis and testing.

What is Computational Intelligence (CI)?

Computational Intelligence (CI) is a set of Nature-inspired computational methodologies and approaches to address complex problems of the real world applications to which traditional methodologies and approaches are ineffective or infeasible. It primarily includes Fuzzy logic systems, Neural Networks and Evolutionary Computation. Computational intelligence techniques are generally bottom-up, where order and structure emerges from an unstructured beginning.

What is Plant Pathology?

Plant Pathology is the scientific study of plant diseases caused by pathogens and environmental conditions. Disease is impairment to the normal state of the plant that modifies or interrupts its vital functions such as photosynthesis, transpiration, pollination, fertilization, germination etc. Organisms that cause infectious diseases include fungi, omycetes, bacteria, viruses, viroids, virus like organisms, phytoplasmas, protozoa, nematodes and parasitic plants. Plant pathology also involves the study of pathogen identification, disease etiology, disease cycles, economic impact, plant disease epidemiology, plant disease resistance, pathosystem genetics and management of plant diseases. The ability to diagnose diseases in earlier stage is very important task. There are numerous characteristics and behaviors of such plant diseases in which many of them are merely distinguishable. Hence an intelligent Decision Support System for Prevention and Control of plant diseases is a must.

Pathological issues are very wide, among which identification of the presence of disease on any part of the plant body is the first and foremost thing in disease treatment. Performing the same with the help of Computational Intelligence finds a great significance in Precision Disease Management.

Precision Agriculture

In this modern era of 21century we are sure that ICT application is going to be implemented as a solution in improving the status of the agriculture sector (Mustafa et.al, 2009). Precision Agriculture merges the new technologies of the information age with a mature agricultural industry. Precision Agriculture is an environment friendly solution system that optimizes the product quality and quantity while minimizing cost, human intervention and the variation caused by unpredictable nature. Precision Agriculture is helping many farmers worldwide to maximize the effectiveness of crop inputs.

The present chapter aims to model a decision support system for disease identification in plants, which helps in precision disease management, a facet of precision agriculture. For the experimentation purpose, pomegranate plant has been considered and disease detection & grading on the leaves has been focused. Next section provides a brief note on pomegranate.

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