Chapter 12
A Hybrid Model for Rice Disease Diagnosis Using Entropy Based Neuro Genetic Algorithm

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ABSTRACT

Disease prediction is often characterized by a high degree of fuzziness and uncertainty. This may reside in the imperfect and complex nature of symptoms that aids in diagnosis.. For precise rice disease diagnosis, domain knowledge of expertise pathologists along with clinically screened database of crop symptoms is considered as knowledge base. The hybrid method pre treats the crop symptoms for removal of noise and redundancy. It forms as target data for rice disease diagnostic model. The Entropy assisted GEANN algorithm reduces the n- dimensionality of diagnostic symptoms and optimizes the target data search space for higher accuracy. Finally the neuro fuzzy system make way for prediction of diseases based on the rules derived from qualitative interpretation of crop symptoms uniqueness. The algorithm is tested for real time case studies of Vellore district, Tamilnadu, India and the results evolved consistent performance against regression, back propagation algorithm and fuzzy network in disease prediction.

1. INTRODUCTION

India has the largest rice output in the world and is also the second largest exporter of rice in the world. In Tamil Nadu, 90% of the farmers belong to small and marginal category and their operational holdings account 56% of the total areas (Shah and Parikh 2012). The adaption of scientific technologies and integrated farming practices by these farmers needs focused attention on overall development in

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agriculture. The use of chemical and cultural methods in pest control increases production costs. It is a major cause of yield loss and lower profits in rice production. Over recent years, pest damage has been amongst the most important factors leading to crop losses and price rises of 8 to 10 percent. In real world, the information available to the pathologist about crop symptoms is inherently uncertain and environment specific. Nevertheless, the pathologist is still quite capable of drawing approximate conclusions from this information. For a human expert, predicting the disease using the clinical data is a laborious and error prone task. The disease predicting data are high dimensional in nature and finding its subset allows supervised learning to induce small/high accuracy concepts. The ranking assisted entropy based feature selection procedure not only reduces the dimensionality but also discards noise-corrupted, redundant and unimportant features. Fuzzy system manipulates and utilizes these data characterized by the unprobabilistic nature of vagueness and uncertainty. The genetic algorithm inspired by natural evolution (Negnevitsky 2011) optimizes the input target data search space in neural network to produce set of rules that is objectively valid. The neural network is capable of predicting new observations from training observations after executing a process called learning from existing data. Neuro-Fuzzy system is an architecture that functionally integrates interpretability of fuzzy inference system with the adaptability of neural network. It has one input, output layer and one/more hidden layers. The hidden layer is defined by antecedents and consequents of fuzzy inference system. The fuzzy rules define inexact medical entities as fuzzy sets. It offers a linguistic approach that represents an excellent approximation of diagnosis texts (Negnevitsky 2011, Hruschka et al., 2004). The objectives of the present study are: (1) to obtain a predictive model based on ANN model for prediction of the percentage of rice disease occurance (2) to optimize the number of training rice disease symptom data by combination of ANN and GA methods.

Most of the computational intelligence algorithms focus on decision support modelling especially for disease diagnosis. It led to substantial progress in understanding of clinical expertise, translation of expertise knowledge into cognitive models, and in the conversion of various models into promising experimental programs. In general, these systems require heuristic and logic in analysis where knowledge is predominant over data. The advancement of computational intelligence algorithms focus on reasoning as computation and logic as the basis for reasoning that creates a set of environment specific automatic processes to translate high level diagnosis descriptions into well coded solutions. Maulik and Bandyopadhyay (2000) proposed that the neuro-fuzzy architecture can be used to encode both structured and non-structured knowledge in the form of fuzzy rules. When domain based reasoning are not well defined through practical examples illustrating their experience, then the neural networks can be trained to represent their experience. Polat and Gunes (2007) developed weighted fuzzy rule-based Clinical Automatic Decision Support System (CDSS) to diagnosis heart diseases by obtaining facts from the patient's clinical data. The knowledge based clinical decision support system used information from medical experts and transferred them into computer algorithms manually. This process was time consuming and really depends on medical experts opinions which may be subjective. Shanthi et al., (2009) methodology of stroke disease showed that the back propagation algorithm based training of the artificial neural networks architecture reduced the error rate and thereby reduced the number of iterations required for reaching appropriate target. Elpiniki and Papageorgiou (2011) used fuzzy cognitive maps as knowledge-based technique using elements of fuzzy logic and neural networks. The knowledge extraction methods used in this study extracted the available knowledge from data in the form of fuzzy rules and inserted into the decision trees, contributing to the development of a dynamic decision support system. Sannakki et al., (2012) modelled an intelligent decision support system for detection and grading of crop diseases which encompasses image processing techniques and soft computing/machine learning techniques. Jaganathan