Evaluation of Expert Fuzzy logic for Plants Diseases

Amosa Babalola, Onyeka Ndidi, Ateko Busayo & Babafemi Olusola
Department of Computer Science
Federal Polytechnic
Ede Nigeria.
E-mail: amosabmg@gmail.com

ABSTRACT

Importance of plants to man and animal growth and development cannot be over emphasized. Plants are affected by a number of diseases which hinders its availability for man and animal consumption. These diseases when detected at the early stage can be treated. Hence the need of fuzzy logic in the management of plant disease. The aim of this study is to evaluate Expert Fuzzy logic for Plants Diseases. A number of related literatures have been reviewed and a conclusion has been drawn on the common type of fuzzy logic mechanism used for the management of plant diseases.

Keywords: Fuzzy logic, Plants, Applications, Expert

1. INTRODUCTION

The theory of fuzzy logic is based on the notion of relative graded membership, as inspired by the processes of human perception and cognition. Fuzzy logic can deal with information arising from computational perception and cognition that is uncertain, imprecise, vague, partially true, or without sharp boundaries. Fuzzy logic can be seen as an extension of ordinary logic, where the main difference is that we use fuzzy sets for the membership of a variable. We can have fuzzy propositional logic and fuzzy predicate logic. Fuzzy logic allows for the inclusion of vague human assessments in computing problems. Also, it provides an effective means for conflict resolution of multiple criteria and better assessment of options. New computing methods based on fuzzy logic can be used in the development of intelligent systems for decision making, identification, pattern recognition, optimization, and control.

Fuzzy logic is extremely useful for many people involved in research and development including engineers (electrical, mechanical, civil, chemical, aerospace, agricultural, biomedical, computer, environmental, geological, industrial, mechatronics), mathematicians, computer software developers and researchers, natural scientists (biology, chemistry, earth science, physics), medical researchers, social scientists (economics, management, political science, psychology), public policy analysts, business analysts, jurists, etc. Indeed, the applications of fuzzy logic, once thought to be an obscure mathematical curiosity, can be found in many engineering and scientific works. Fuzzy logic has been used in numerous applications such as facial pattern recognition, air conditioners, washing machines, vacuum cleaners, antiskid braking systems, transmission systems, control of subway systems and unmanned helicopters, knowledge-based systems for multiobjective optimization of power systems, weather forecasting systems, models for new product pricing or project risk assessment, medical diagnosis and treatment plans, and stock trading. Fuzzy logic has been successfully used in numerous fields such as control systems engineering, image processing, power engineering, industrial automation, robotics, consumer electronics, and optimization. This branch of mathematics has instilled new life into scientific fields that have been dormant for a long time [1].

1.2 Fuzzy Inference System

The fuzzy inference system is the process of formulating the mapping from a given input to an output. The logic in the system is built on the experience of people who understand the system to be modeled in natural language. The statement of if-then (or rules) is the main mechanism in the fuzzy inference system. This fuzzy inference system makes the system natural and beneficial to model a complex humanistic in the loop system. [2] Showed that a fuzzy inference system is capable of approximating any real continuous function to arbitrary accuracy, and this is a basis from which decisions can be made, or patterns discerned. The main components are a fuzzification interface, a fuzzy rule base (knowledge base), an inference engine (decision-making logic), and a defuzzification interface. The input variables are fuzzified whereby the membership functions defined on the input variables are applied to their actual values, to determine the degree of truth for each rule antecedent. Fuzzy if-then rules and fuzzy reasoning are the backbones of fuzzy expert systems, which are the most important modeling tools based on fuzzy set theory.

The fuzzy rule base is characterized in the form of if-then rules in which the antecedents and consequents involve linguistic variables. The collection of these fuzzy rules forms the rule base for the fuzzy logic system. Using suitable inference procedure, the truth value for the antecedent of each rule is computed and applied to the consequent part of each rule. This results in one fuzzy subset to be assigned to each output variable for each rule. Again, by using suitable composition procedure, all the fuzzy subsets assigned to each output variable are combined together to form a single fuzzy subset for each output variable. Finally, defuzzification is applied to convert the fuzzy output set to a crisp output. The basic fuzzy inference system can take either fuzzy inputs or crisp inputs, but the outputs it produces are always fuzzy sets. The defuzzification task extracts the crisp output that best represents the fuzzy set. With crisp inputs and outputs, a fuzzy inference system implements a nonlinear mapping from its input space to output space through a number of fuzzy if-then rules [3].

2. LITERATURE REVIEW

In Oliver et.al [4], their research is based on logical control of greenhouse; in which greenhouse provide optimal microclimate condition for plant growth. Fuzzy logic based controller of greenhouse generates control strategies based on linguistic variable. This approach allows for human expert knowledge to be in corporate into computer based control. The reason for this approach are high cost of integrated control system and the lack of a general system model which will cover important controlled and disturbing variable.

Sanjeev et.al [5] is a research based on an approach to automatically grade the disease on plant leaves; it has been proved that fuzzy logic can be inculcated effectively and efficiently in the agriculture domain covering a wide range of precision agriculture applications such as texture analysis, agriculture produce grading, effective use of herbicide sprayers in disease control etc. Hence, in the present work Fuzzy Logic (FL) is used for the purpose of disease grading. As it is realized the system is an approach to automatically grade the disease on plant leaves is very much essential in the present scenario. The Grading System built by Machine Vision and Fuzzy Logic is very useful for grading the disease. This kind of expert system is going to help pathologists as it overcomes almost all the disadvantages of manual grading in terms of complexity and time. The observed results through experiments are found to be accurate and satisfactory.

The research of Latit and Sangeetha [6] based on the uses of fuzzy logic systems with the help of some wireless technologies in efficient farming of tomato crop which is an important and profitable is presented.

As of now, farmers are using certain techniques of irrigations and disease control in crops manually. While using these techniques, some delays can occur because of some unavoidable reasons then it affects the crop. For that reason, an automatic irrigation and disease control system based totally on sensing devices is required to reduce the manpower and to take appropriate decision which leads to the profit. By implementing this technology in the farm, many things which are now requiring a considerable amount of man power can be handled automatically.

In Soundararajan et.al [7] a fuzzy rule based system designed to serves as decision support for tuberculosis diagnosis is proposed. It is to develop a prototype warning system for clinical activity, based on the assumption that clinical problems can be analyzed in many simple rules, the decision process of the physician can be modeled by sets of these rules. It was concluded that fuzzy logic was used to formalize approximate reasoning in medical diagnostic system and it helps in the decision making of the pulmonary physician in giving the diagnosis.

The research of Derwin et.al [8] indicates the importance of coffee commodity in the world economy. And also noted that productivity and quality of those commodities results are still quite low. Which is cause by the disease in coffee plants. They research objective is to create an application that can help other researchers or observers working in coffee plantation to diagnose diseases of coffee plants faster. The method which is to be use is fuzzy logic-based expert system and decision tree using a hierarchical classification. Based on the accuracy, it can be concluded by the researcher that this application can be a bit much to help researchers or observers of the coffee plants in diagnosing coffee plants diseases earlier.

Vipinadas.and Thamizharasi [9] presented a research that explained the diseases on the banana are crucial issue which makes the sharp decrease in the production of banana. They as indicate that banana require careful diagnosis and timely handling to protect the crops from heavy losses because now a day's crop faces many diseases. It also noted in their research that naked eye observation of experts is the main approach adopted in practice for detection and identification of banana leaf diseases. And they proposed that automatic detection of banana plant diseases are an important topic as it may prove benefits in monitoring large field of crops, and thus automatically detect diseases from symptoms that appear on plant leaves. The techniques to be used is image processing technique. The proposed system is also a well-organized module that identifies the Blacksigatoka disease and Panama wilt disease on banana leaf. Finally, classifiers comparison has been performed using confusion matrix. 3

In Sanjeev et.al [10] presented the usefulness and emphasis on the diseases related with grape fruit and how to diagnose them. The researchers aim at processing the images with complex background, varying lightening conditions and clicked from various distances. This makes the system more dynamic to work under various climatic conditions. In Ghobakhlou et.al [11] the presence of water on plant surface that influenced many biophysical processes such as the development and spread of fungal and bacteria diseases is proposed. For a fungal disease to occur, certain environmental conditions have to be fulfilled, including a specific duration of wetness on the leaf surface, since LWD is an important factor to consider in the development of certain foliar disease. This paper used Adaptive Neuro-fuzzy interference system (ANFIS) to estimate Leaf wetness duration (LWD), where ANFIS is a hybrid system that combines fuzzy logic and neutral network techniques that tends to take advantage of both paradigms to assess the condition of leaf surface.
The research of Moussa et.al [12] is based on how to use crop planting date as an agricultural management strategy to support agricultural decision making in Sub-Saharan African (SSA) and it is approach at optimizing crop and location specific planting dates. In other to achieve this the researchers make use of

fuzzy logic-based planting rules in combination with a large scale crop model where maize has been chosen as the target crop for simulation. Their research account for crop-specific mete0rological and soil requirement during the whole growing period

Mohid et.al [13] presents an integrated method for recognizing diseases on paddy plant leaves and provides the user with recommendations on how to overcome and control the diseases. The researcher aims to solve these problems by developing an integrated method in recognizing paddy diseases at their early stages and give recommendations on how to solve and control it. In other to achieve this, the researchers develop a prototype that is able to recognize paddy disease and give recommended solutions based on the type and stages of the paddy disease.

The research of Savita et.al [14] is based on diagnosis of soybean disease. Based on their research, presently more than 100 diseases have been reported to inflict soybean crop in different parts of the country. Their aim is to deliver real time crop disease diagnosis and provides customized expert knowledge with the aim of improving decision making for farmers for effective agro-management which will lead to increase in production and hence increase the National income.

The research of Sujeet et.al [15] focuses on SVM algorithm and this algorithm takes input image in RGB form and detect the infected part of the disease. After detecting the infected part of the disease the whole infected part will be calculated in the terms of percentage % and the disease will be detected. And it was concluded that the use of Spectroscopic and imaging technique which include fluorescence imaging and hyper spectral imaging has been used for plant disease detection.

Vidita et.al [16] indicated in their research a comprehensive approach called Integrated Pest Management (IPM) that integrates a variety of practices to reduce the loss of farm productions due to pests and pathogens with optimum use of pesticides. They also stated that early detection of pest and its control is one of the aspects of IPM. Using various meteorological data like temperature, humidity, leaf wetness duration (LWD) plays the vital roles in the growth of microorganism responsible for disease. Weather based forecasting is well accepted method for this. Weather based forecasting system can be considered as a part of the Agricultural Decision Support System (ADSS) which is Knowledge Based System (KBS). The researcher proposes fuzzy logic based structure for the plant disease forecasting system.

3. CONCLUSION

Evaluation of various Expert Fuzzy logic for Plants diseases have been presented in this study. In their evaluations, different approaches were used but a common denominator is that they have all employed the basic fuzzy logic mechanism. Fuzzy logic mechanism has been confirmed as veritable and dynamic tool in diagnosing plant diseases.

REFERENCES

[1] S. Harpreet, M. M. Gupta, T. Meitzler, H. Zeng-Guang, K. K. Garg, and A.M.G. Solo (2013) Special Issue of Advances in Fuzzy Systems on Real-Life Applications of Fuzzy Logic. Hindawi Publishing Corporation.

[2] L.X. Wang and J.M. Mendel, (1992) Generating Fuzzy Rules by Learning from Examples. IEEE Transactions on Systems, Man, and Cybernetics, 22, pp. 1414-1427. http://dx.doi.org/10.1109/21.199466.

[3] B. Möller. Uncertainty in Engineering, Fuzziness, 2005. URL:http://www.uncertainty-in-engineering.net/uncertainty_models/fuzziness

[4] L.I. Oliver, S. Payle, Z. Ahmad (2012). Fuzzy Logic Based Controller for Integrated Control of Greenhouses. Conference for Informatics and Information Technology.pp.339-343.

[5] S.S. Sanjeev, S.R. Vijay, V.B. Nargund, K.R. Arun, S.Y. Prema. (2011). Leaf Disease Grading by Machine Vision and Fuzzy Logic. International Journals of Computer Technology and Application, Volume2, Issue 5, pp.1709-1716.

[6] R.A. Lalit, R. Sangeetha (2015). Fuzzy Logic System in Tomato Farming. IOSR Journal of Computer Engineering, pp.56-62

[7] K. Soundararajan, Sureskhumar S. C. Anusuya (2012). Diagnostics Decision Support System for Tuberculosis using Fuzzy Logic. International Journal of Computer Science and Information Technology & Security., Volume 2, Issue 3, pp. 684-689.

[8] S. Derwin, A. Wahyu, L. Miranty, Y. Muhammad (2013). Expert System in Detecting Coffee Plant Diseases. International Journal of Electrical Energy., Volume 1, Issue 3, pp.156-162.

[9] M.J. Vipinadas, A. Thamizharasi (2016). Detection and Grading of diseases in Banana leaves using Machine Learning. International Journal of Scientific & Engineering Research, Volume 7, Issue 7, pp.916-924.

[10] S.S. Sanjeev, S.R. Vijay, V.B. Nargund, K. Pallavi (2013). Diagnosis and Classification of Grape Leaf Diseases using Neural Networks. IEEE.

[11] A. Ghobakhlou, F. Amir, J. Whallay, P. Sallis (2015). Estimation of Leaf Wetness Duration Using Adaptive Neuro-Fuzzy Inference Systems. International Congress on Modelling and Simulation. pp. 585-591

[12] W. Moussa, L. Patrick, B.T. Seydou, S. Moussa, R. Harald (2013). A Crop Model and Fuzzy Rule Based Approach for Optimizing Maize Planting Dates in Burkina Faso, West Africa. Journal of Applied Meteorology and Climatology, Volume 53, pp. 598-613.

[13] A.A. Mohid, M. Sofianita, A. Shuzlina. Early Detection and Classification of Paddy Diseases with Neural Networks and Fuzzy Logic. Recent Advances in Mathematical and Computational Methods, pp. 248-257.

[14] K. Savita, K. V, S.S. Harvinder, G.K. Gupta (2009). A fuzzy-logic based on-line disease diagnosis system for soybean.

[15] V. Sujeet, D. Tarun (2016). A Novel Approach for the Detection of Plant Diseases. International Journal of Computer Science and Mobile Computing, Volume 5, Issue 7, pp. 44-54.

[16] T. Vidita, P. Jignesh, B. Chetan. (2013). Weather Based Plant Diseases Forecasting Using Fuzzy Logic. Nirma University International Conference on Engineering.