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Artificial Neural Networks in Agriculture: A Survey

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Abstract: In many fields, including agriculture, neural networks have become a very effective method. In this paper, we discuss the applications of neural networks in the field of agriculture, including their advances, specifically in classification, decision-making, pattern recognition, crop yield prediction, plant identification, classification of weed images, remote sensing, identification of plant diseases, precision farming, and agricultural enhancement spatial data analysis. Among these, computer techniques in the field of agriculture are also based on neural networks, especially in the sense of soil and water. The survey was used to convey information about applications, processes, future innovations, and challenges in applying Artificial Neural Network (ANN) techniques in agricultural innovations.

Keywords: Artificial Neural Networks, Agriculture, Soil Classification, Crop Management, Plant Disease.

INTRODUCTION

Neural networks are computer systems that can be equipped to learn about two or more variables in a complex relationship. The structures are similar to their biological counterparts in Neural Networks. Neural Networks are computational models that simultaneously process data in a distributed way. It can be representative, too[1]. Neural net techniques have been effectively applied in various fields. This study paper helps to explain the efficacy and accuracy of techniques applied to broad data sets of neural networks. It takes more time and is too costly to use traditional statistical analysis techniques. This type of research would boost soil management outcomes, precision farming and overall agricultural productivity by reducing fertilisers. There are some restrictive assumptions for statistical methods among input variables, as is also the case with agricultural data. The implementation of Artificial Neural Networks and other soft computing techniques employed to agricultural data include qualitative methods.

Artificial Neural Networks is a form of soft computation that is modelled on the way human brains function. The neural network is programmed to learn by changing the weights in positive ways when it gets a right result, and in negative ways when it receives an incorrect result. Missing data, outliers and regression can be addressed by the ANN. The latest research focuses on the application of ANN in agricultural science, especially in the fields of yield estimation, spatial modelling and spatiotemporal forecasting. The aim of this article is to address the use of ANN in agricultural research and to explore the empirical problems of neural networks. While a number of issues remain and have not been solved successfully, significant progress has been made in ANN and other related fields. [2].

1. APPLICATIONS OF ARIFICIAL NEURAL NETWORKS

Models based on the Artificial Neural Network (ANN) have been investigated for use in different applications of agricultural and agricultural machinery. The applications are based on multiple ANNs for inputs and single outputs that can be used to model linear and non-linear surfaces [3]. Where response surface modelling has been used in the past, these types of models may be efficient .A major impetus for examining the application of ANNs in agriculture has been the quick expansion of cost-effective control systems available for use in agricultural machinery, for some of the machinery applications such as predicting yield response in precision farming , machine output and plant characteristics using sensor signals.

Sensor technologies have seen similar developments in agriculture, and the cost-performance ratio for sensors and computers has increased, while the climate for the application of electronic technology in agricultural machinery is improving. The development of cost-effective sensors, such as computers, presents a natural problem with the need for effective models to allow the exercise of control. An example of this issue is a great interest in precision farming. A principle in map-based precision farming is that, combined with maps of past yields, the creation of soil fertility

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characteristics maps is used to predict the required fertilisation for the current year. To allow map-based precision farming to succeed, further models are needed. ANNs are a natural solution to an analytical model of this kind.

Theoretical or experimental models will take a lot of time and people than are available, whereas empirical models can be tailored to a specific scenario, e.g. in the case of precision farming, a particular grower's sector. There are several convenient tools available that allow the fitting of neural network models to empirical datasets. The availability of software development packages for ANN can be contrasted with the available non-linear regression packages. The neural network choice looks appealing from the perspective of the variety of development packages available. ANNs are more noise-tolerant than conventional regression-based analytical modelling. In addition to noise tolerance, a related function is the ability to operate effectively in the presence of missing data. [4].

1.1 Drip Irrigation System

This paper explores the possibilities that NN can provide for irrigation, describes the impact of important irrigation water model technologies used in this area, and it was done using enhanced genetic algorithm and NN algorithm back propagation. It utilizes an enhanced BP neural network algorithm that forecasts maize yield for various systems of drip irrigation. The prediction was correct and the average rate of error was reduced [5]. It clearly pictured the relationship between irrigation and the yield.

1.2 Maize Plant Detection

This article is about weed control in maize farming using the neural network model of back propagation. One of the costly activities of agriculture is weed control. The proposed structure is tested on images with varying light conditions on images that have no clear distinctive geometric pattern[14]. As the manual separation of the maize plant from the other harmful weeds takes time, the BPNN results obtained were inspiring.

1.3 Viticulture

This paper explores the opportunities that NN can provide for viticulture, explains the effect that has been important of the technologies used in this area, and improvements can be seen in the entire wine industry. The centuries-old Mediterranean grape growing and wine - making industry uses ANN techniques to improve farming methods to explore the relationship between farmers and environmental factors, such as climate and soil. [12]. Over the past two decades, research has been carried out to gain a more comprehensive understanding of regional factors and the early admission of computing into viticulture, and geo-referenced analysis of the data with rule-based expert systems (ES) has also begun. The data outcomes of geospatial data analysis, especially in agriculture, horticulture and viticulture, need to be more accurate. [13]. Previous research approaches were combined with state-of-the-art computational technologies by the writers. Previous scientific methods for the capture, transfer and analysis of data using artificial neural and fuzzy networks were integrated by the authors with state-of-the-art technological tools.

1.4 Drought Projections

This article explores the relationships between long-term dryness and wetness due to El Nino during the year 2015 to 16 by using Recurrent Neural Networks (RNNs). When comparing, 1998 to 99 El Nino, the Palmer Z Index (PZI) confirms drought in the long-term forecast that El Niño is expected to bring adequate rainfall to the region. RNN used to test the precipitation forecast and found a strong link between expected and observed statistically noteworthy [6].

1.5 Frost Control in Greenhouses

The use of ANN to manage frost in green houses is discussed in this article. Frost is a major technical challenge. Thermal comfort helps improve greenhouse productivity; it needs a great deal of heating and ventilation energy. To control frost in greenhouses in the region of Mexico, a Multi-Layer Perceptron ANN, trained using a Levenberg-Marquardt back propagation algorithm[7]. This smart frost control system forecasts summer and winter temperatures and acts accordingly.

1.6 Prediction of Soil Texture

The contribution deals with the prediction of soil texture using the Feed Forward Neural Network (FFNN) model, an artificial neural network approach. This method was compared using data from the remote sensing department with the Self Organizing Map (SOM),for the percentage of sand, silt and clay, soil samples were analysed. The information

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obtained from field observations was used to create the model of the neural network. An experimental outcome indicates that FFNN 's success works well [11].

1.7 Remote Sensing Scene Classification

The application of Convolutional Neural Networks (CNN) to remote sensing datasets is discussed in this article. CNN should be learned, fine-tuned and used on remote sensing data, like other neural networks. Three remote sensing datasets with six common CNN data sets were used for experiments and the results were compared. This paper also addresses information technology based crop disease prediction system that alerts farmers about the disease affecting crops and the prevention and treatment to be done for data analysis through mathematical modelling techniques. Computer technology contributes greatly to the identification of pests [8]. The authors find that the semi-supervised learning algorithm is successful.

1.8 Forecasting Agricultural Production

This article is about the use of information technology (IT) in agricultural production forecasts. While several techniques such as B-J and ARMA are available, the authors found that the forecast for neural networks is better than any other. For forecasting, BP net, GRNN are used and found that BP net learns well and GRNN prediction rate is high and can perform well even with limited amounts of data and its prediction of rural grain production is good, but it was not suitable for nonlinear and multivariable[15]. Convergence rate is fast in GRNN and it have good predictive ability.

1.9 Pistachio Nuts Classification

Pistachio is an expensive agricultural commodity and prices depend on its quality. It is an important issue to assess the excellence of closed head pistachio from the point of view of economy, export and marketing. This article is about using artificial neural networks (ANNs) to construct an intelligent classification system for pistachio nuts. Pistachio is a valuable product of farming. ANN was trained by analysing acoustic signals produced from pistachio force with a steel plate for this device. The algorithm for Principle Component Analysis (PCA) is used to limit the signal size. In order to compare the experimental results, different forms of ANN were used and the proposed method gave the precision of 99.8. A multilayer with hyperbolic tangent sigmoid transfer helps to distinguish the receiving signals and others, of the signals received, 75% were used for network training and 25% were used for testing[9].

1.10 Corn Plant Disease Recognition

This article suggests a real-time approach based on a deep convolutionary neural network for the identification of maize leaf disease. It is possible to use latest access to smart devices to automatically diagnose maize diseases and prevent significant crop losses. Deep neural network performance is increased by tuning the hyper-parameters and adjusting the pooling combinations on a GPU system. Furthermore, the set of parameters of the built model is modified to make it suitable for real time inference. The pre - trained CNN model was tested on raspberry pi 3, during the detection of maize leaf diseases, using Intel Movidius Neural Compute Stick, consisting of dedicated CNN hardware blocks. [10]

2.CONCLUSION AND FUTURE WORK

Research efforts have made significant strides in both theoretical advancement and practical applications. Neural networks have been demonstrated as a good alternative to traditional classifiers for many other practical classification problems. In performing classification as well as other functions, some insights were also acquired into the neural networks. Many problems in Neural Networks are not solved or are not fully solved. In the identification of neural models, feature variable selection, and classification, more study must be dedicated to building more accurate and effective methods. This paper, which discusses the use of neural networks in agriculture, illustrates how neural networks have been used to increase agricultural productivity. Although the prediction of neural networks is not ideal, they outperform all other techniques and give hope for a better system than conventional ones. Research efforts have made significant strides in both theoretical advancement and practical applications. Neural networks have been demonstrated as a competitive alternative to traditional classifiers for many other practical classification problems.

As researchers and investors aim to outperform the market, with the goal of improving their returns, using neural networks to study areas. On more complex topics, interesting findings and confirmation of hypotheses are applied. In this area, the key research goal is to provide better network architectures with high performance accuracy. Good output is provided by the widely used back propagation network, but this output could be enhanced by using recurrence or reusing past inputs and outputs. As they capture nonlinearities in the system without human interference, neural networks are one of the best

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modelling methods currently available. Continued research on improving the performance of the neural network could lead to further insights into the nature of modelling systems. A perfect predictor will always be the neural network.

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