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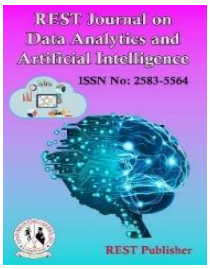

Machine Learning Techniques in Agriculture

[*]M. Menaha, J. Lavanya
AdaikalaMatha College, Vallam, Thanjavur, Tamil Nadu, India.
[*]Corresponding Author Email: menaha.m1989@gmail.com

Abstract: *Food is considered as a basic need of human being which can be satisfied through farming. Agriculture not only fulfils human's basic needs, but also considered as source of employment worldwide. Agriculture is considered as a backbone of economy and source of employment in the developing countries like in India. Indian farmer still struggles when it comes to picking up the right crop for right biological and non-biological factors. Thus, to accelerate the yield of crops, different AI techniques been proposed worldwide. Advancement in area of machine learning has helped improving gains in agriculture. Machine learning is the current technology which is benefiting farmers to minimize the losses in the farming by providing rich recommendations and insights about the crops. This paper presents an extensive of latest machine learning techniques in agriculture. Techniques of machine learning in agriculture allows more efficient and precise farming with less human manpower with quality production.*

1. INTRODUCTION

Agriculture has been the cornerstone of almost all the ancient civilizations for the very primary reason for sustenance. Today, agriculture is a $2.4 trillion industry worldwide is one of the most prominent contributors to the development of third world countries. However, agriculture inherently faces many problems, most of which are highly unpredictable in nature, lack of rain, floods, blight drastic weather changes to name a few. These factors along with the unmeasured use of insecticides and chemical fertilizers, institutional factors like lack of credit, not enough subsidies by the governing body and corruption lead to alienation of the farming body and an increase in the debt which ultimately leads to suicides and families laden with more debt. The above reasons necessitate the ushering in of Artificial Intelligence and the Internet of Things [1] in the field of agriculture to use statistical prowess to provide better yields at relatively lower costs. Along these lines, we present various frameworks based on precision agriculture.

2. AN OVERVIEW ON MACHINE LEARNING

Machine Learning methodologies involves a learning process with the objective to learn from "experience" (training data) to perform a task. The performance of the ML model in a specific task is measured by a performance metric that is improved with experience over time. To calculate the performance of ML models and algorithms, various statistical and mathematical models are used. After the end of the learning process, the trained model can be used to classify, predict, or cluster new examples (testing data) using the experience obtained during the training process. Tasks of Learning ML tasks are classified into two main categories, that is, supervised and unsupervised learning, depending on the learning signal of the learning system. In supervised learning, data are presented with example inputs and the corresponding outputs, and the objective is to construct a general rule that maps inputs to outputs. In some cases, inputs can be only partially available with some of the target outputs missing or given only as feedback to the actions in a dynamic environment (reinforcement learning). In the supervised setting, the acquired expertise (trained model) is used to predict the missing outputs (labels) for the test data. In unsupervised learning, however, there is no distinction between training and test sets with data being unlabelled. The learner processes input data with the goal of discovering hidden patterns. Analysis of Learning Dimensionality reduction (DR) is an analysis that is executed in both families of supervised and unsupervised learning types, with the aim of providing a more compact, lower dimensional representation of a dataset to preserve as much information as possible from the original data. It is usually performed prior to applying a classification or regression model in order to avoid the effects of dimensionality.

Some of the most common DR algorithms are the following: (i) principal component analysis [2], (ii) partial least squares regression [3], and (iii) linear discriminant analysis [4].

3. TECHNIQUES IN MACHINE LEARNING

Machine learning techniques in agriculture rely on real-time data to deliver exponential gains for farmers. AI and machine learning prove to be strong catalysts driving 24/7 security of remote facilities, better yields, and pesticide effectiveness. Prediction of crop can be performed by using various machines learning algorithms such as mathematical and statistical method etc.

3.1 Artificial Neural Network:

Artificial Neural Network (ANN) is the network of artificial neurons. It is based on the human brain's biological processes. It is one of the examples of supervised learning. Neural network has to be trained once, thereafter similar patterns in future data can be predicted for instance, meaningful solutions to problems can be produced even if the input data is incorrect/ incomplete. Accuracy of ANN goes on increasing by the addition of more and more data. Also ANNs are capable of adopting their complexity without knowing the underlying principles. ANN can derive relationship between input and output on any process. In developed a model for corn and soybean yield forecasting [5] with climatic aspect by applying artificial neural network. They have considered the rainfall, Maryland corn and soybean yield data and predict the corn and soybean yield at state, regional and local levels by applying both the artificial neural network technique and the multiple linear regression model. Lastly they compared both the techniques and conclude that the ANN model gives more accurate yield prediction than the multiple linear regressions. In [6] applied machine learning (ML) techniques for Maize breeding as revealed those ML algorithms are promising and can be used in statistical techniques applied in maize, alike the more newly popularize linear mixed models. Among the current technology available for expedite the releasing for new genotypes there is an emerging subject of ML. Several strategic uses of ML in maize breeding, quantitative trait loci mapping heterotic group assignment and the popular genome-wide selections are few of the main areas presently address by the literature. Corn is one of the most important cereals in the world and a primary source of calories for human being along with rice and wheat the evolution of genotypes adapted to aggravating climate, particularly drought situation which has to be grown in marginal law and changing climatic condition for crop production. In[7] used the neural network model to study for the development of a model for oil palm yield. They took the percentages of nitrogen, phosphorous, potassium, calcium and magnesium in leave as input variables and fresh fruit bunch as the target variable. Combining the activation function, learning rate, momentum term, number of runs, and number of hidden nodes with all the layer they found that it affects the neural network performance. In[8] used the artificial neural network to predict the crop by using the soil parameters such as types of soil, pH, nitrogen, phosphate, potassium, organic carbon, calcium, magnesium, sulphur, manganese, copper, iron, depth and climate parameters such as temperature, rainfall, humidity. They did the experiment on the crops such as Cotton, Sugarcane, Jawar, Bajara, Soyabean, Corn, Wheat, Rice and Groundnut.

3.2 Decision Tree: The decision tree models include the concepts as nodes, branches, terminal values, strategy, payoff distribution, certain equivalent, and the rollback method. There are three kinds of nodes and two kinds of branches. The decision node which is represented as square is a point where a choice must be made. The decision branches are extending from a decision node. Each terminal node has an associated terminal value, sometimes called a payoff value, outcome value, or endpoint value. The result of a scenario or the sequences of decisions are measured by each terminal value. There are two step processes for the construction of a decision tree algorithm- first, growth of large decision tree then reduction of size and over fitting the data, in the second step, and tree is pruned. The pruned decision tree that is used for classification purposes is called the classification tree described [9]. In [10] described the soybean productivity modelling using decision tree algorithms. They had collected the climate data of Bhopal district for the period 1984-2003. They considered the climatic factors such as evaporation, maximum temperature, maximum relative humidity, rainfall and the crop were soybean yield. They have applied the Interactive Dichotomizer3 (ID3) algorithm which is information-based method and based on two assumptions. Using the induction tree analysis, it was found that the relative humidity is a major influencing parameter on the soybean crop yield. Decision tree formed for influence of climatic factors on soybean yield. Using the if-then-else rules the decision tree is formulated to classification rules which are Relative humidity affects much on the production of soybean and some rules generated which help to in the low and high prediction of soybean. One of the drawbacks was only the low or high yield can be predicted but the amount of yield production cannot be predicted [11].

3.3 Clustering: Cluster analysis or clustering is the process of identifying objects that are similar to each other but different from individuals in other groups. It is mainly used for data analysis. Clustering is used in many fields such as machine learning, pattern recognition, image analysis, information retrieval, and agriculture etc. There are various clustering algorithms are there such as k-means, k-medoid etc but the common and important clustering algorithm is k-means. In [12] demonstrates an evaluation of modified k-Means clustering algorithm in

crop prediction. Their results and evaluation showed the comparison of modified k-Means over k-Means and-Means++ clustering algorithm and found that the modified k-Means has achieved the maximum number of high quality clusters, correct prediction of crop and maximum accuracy count. Based on the frequency of variables available by the weather forecast model by [13] classifies the metrological data. They have identified the patterns that are associated to severe convective activity. For some selected mini-regions of Brazil during summer of 2007 their result showed good classification performance. They thought that their metrological model Eta serve as a support tool for meteorologists to identify patterns in advance.

3.4 Bayesian Belief Network:

A Bayesian network or Bayes network or belief network or Bayesian model or probabilistic directed acyclic graphical models a type of statistical model. A belief network to assess the effect of climate change on potato production was formulated by [14]. They have shown a belief network combining the uncertainty of future climate change, considering the variability of current weather parameters such as temperature, radiation, rainfall and the knowledge about potato development. They thought that their network give support for policy makers in agriculture. They test their model by using synthetic weather scenarios and then the results are compared with the conventional mathematical model and conclude that the efficiency is more for the belief network.

4. CONCLUSION

Now-a-days a growing number of applications of machine learning techniques in agriculture are required for which a large amount of data currently available from many resources can be analysed to find the hidden knowledge. This is an advanced researched field and is expected to grow in the future. The integration of computer science with agriculture helps in forecasting agricultural crops. It is required to build on objective methodology for pre-harvest crop forecasting. Building up a suitable model will have certain merits over the traditional forecasting method.

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