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Agriculture Crop Enhancing Identification and Classification using Machine Learning Techniques

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Abstract: Crop identification and classification are the keystone of satisfactory agricultural development. Crop yield prediction has been a topic of interest for producers, consultants, and agricultural related organizations. Many Techniques are used for crop yield prediction, including supportive decisions on what crops to grow and what to do during the growing period of the crops. In this paper, we performed a Literature survey on Yield prediction with different machine learning algorithms for satellite images with Climatic Parameters, also we survey on Wheat yield prediction using different machine learning algorithm and advanced sensing Techniques, also we survey on how to perform Measurement and Calibration of Plant-Height.

Keywords: Crop identification, Crop Classification, Yield prediction, Machine Learning.

1. INTRODUCTION

As we are aware of the fact that, most of Indians have agriculture as their occupation. By looking at the past few years, there have been significant developments in how Computer vision and machine learning can be used in various industries and research. So, in this paper we performed literature survey on Yield prediction with different machine learning algorithms like BPNN, DT, KNN, GPR, CP-ANN, XY-F, SKN. Also we survey on how to perform Measurement and Calibration of Plant-Height.

2. MACHINE LEARNING TECHNIQUES

There are two broad categories of machine learning algorithms: Supervised learning and Unsupervised learning.

2.1 Supervised learning

Supervised learning uses a known set of labelled data to train a model to predict the target variable for out of sample data [1]. Classification and regression techniques are common applications of supervised learning. The list of machine learning algorithms that fall under the different techniques is highlighted in Fig. 1 [3].

2.2 Unsupervised learning

Unsupervised learning depends on hidden patterns or fundamental structures in data to draw deductions from unlabelled data. It is useful for exploratory applications where there is no specific set goal, or the information the data consists is not clear. It is also ideal as a mechanism for dimensionality reduction on data that have a number of features. Clustering is the most common learning model under this type of learning, and its application extends to exploratory data analysis, such as gene sequencing and objects recognition. [2]

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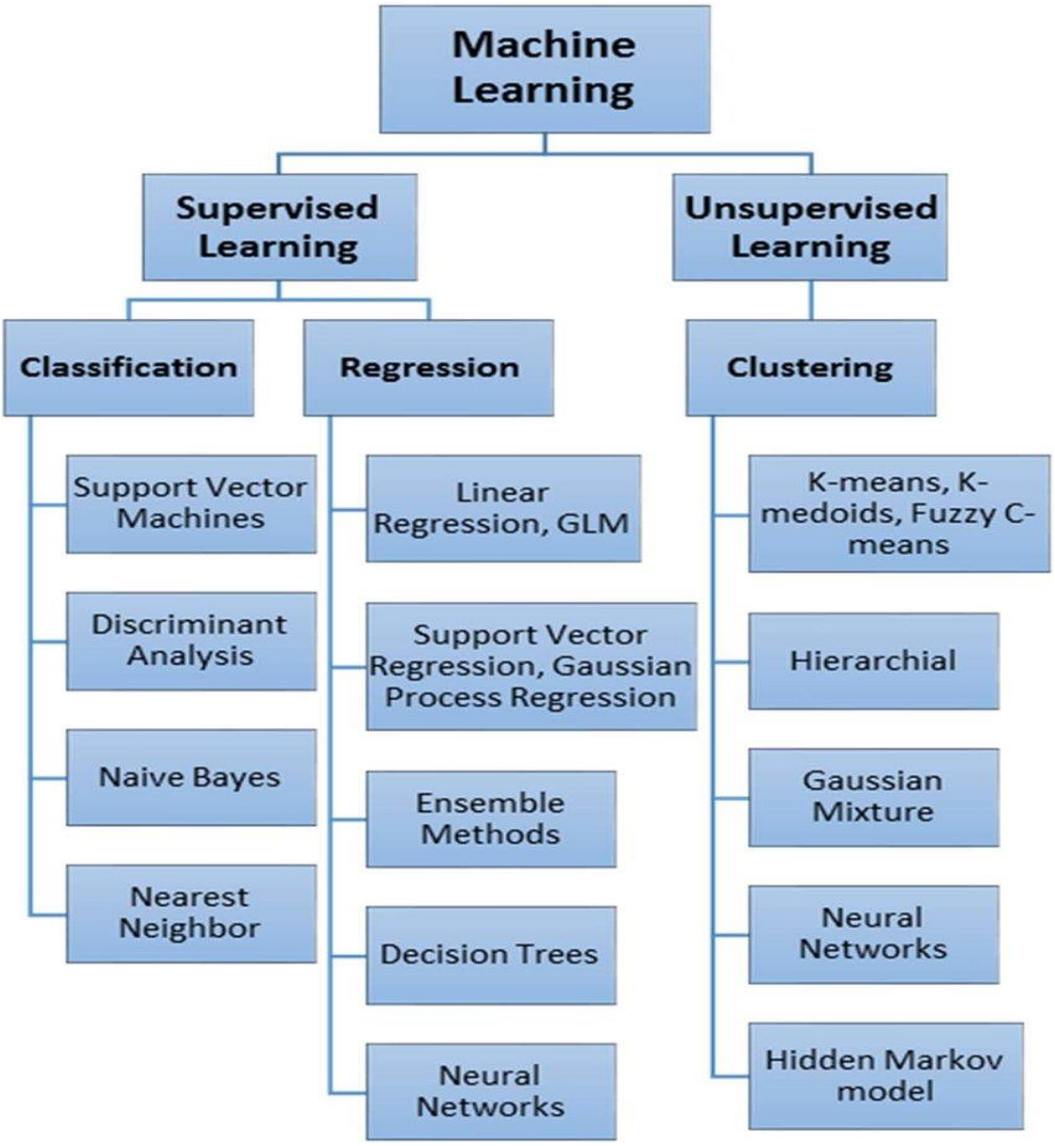

Fig 1. Machine learning algorithms.

3. YIELD ESTIMATION

Achieving maximum crop yield at minimum cost with a healthy ecosystem is one of the main goals of agricultural production. Early detection and management of problems associated with crop yield restrictions can help increase yield and subsequent profit, and estimating yield is important to numerous crop management and business decisions.

In recent years different Machine Learning techniques have been implemented to achieve accurate yield prediction for different crops. One of this research is Yield prediction with machine learning algorithms and satellite images [4]. In that study research was done for Barley is one of the top three grains (wheat, rice and barley). Study Area for research is Boshruyeh city in Iran. Field data for that research was Barley yield data from 2015 to 2019 were collected in 24 plots. [4] Data Collected for that research by Sentinet-2 satellite.

One Machine Learning Methods used in that research was Backpropagation neural network (BPNN), A BPNN is one of the most widely used artificial neural networks, which usually consists of one input layer, one output layer and several hidden layers. The input layer only enters the data. The neurons in the hidden layer begin to analyze and process the data, and the results are eventually transferred to the output layer through the transfer function.

Second Machine Learning Methods used in that research was Decision tree (DT) The DT is a useful tool for solving classification and regression problems and has been widely used as a non-parametric model in remote sensing [4][5][6]. The decision tree is a method for approximating the performance of a discrete value, which is robust to noisy data [4][7].

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Third Machine Learning Methods used in that research was K-nearest neighbor regression (KNN), The K-nearest neighbor is a simple algorithm that stores all available cases and predicts the numerical target based on a similarity measure (e.g. distance functions) [4][8] Another approach uses an inverse distance weighted average of the K nearest neighbors. KNN regression uses the same distance functions as KNN classification [4][9].

Forth Machine Learning Methods used in that research was GPR. GPR is a non-parametric, Bayesian approach to the regression that is making waves in the area of machine learning. GPR has several benefits, working well on small datasets and having the ability to provide uncertainty measurements on the predictions. Unlike many popular supervised machine learning algorithms that learn exact values for every parameter in a function, the Bayesian approach infers a probability distribution over all possible values [4].

The results showed that the GPR method had the highest prediction accuracy and showed the best generalization ability compared to the others. The GPR model was able to accurately estimate barley yield approximately 1 month before harvest [4]. For this used Climatic Parameters as Precipitation, Temperature and Drought.

Another research for Yield prediction is Wheat yield prediction using machine learning and advanced sensing techniques [10]. In that study research was done for Wheat is one of the top three grains (wheat, rice and barley). Study Area for research is Wilstead, Bedfordshire, U.K. Data Collected for that research by UK-DMC 2 satellite.

For the purpose of covering specific needs, unsupervised models have been extended so as to be capable of working in a supervised manner. Methods like CP-ANNs, XY-Fused network, Supervised Kohonen networks [10].

One Methods used in that research was Counter-propagation artificial neural networks (CP-ANN) [10]. CP-ANNs are regarded as modeling methods, capable of combining features from not only supervised but also unsupervised learning techniques [11]. CP-ANNs comprise of two layers, namely, a Kohonen and an output layer. Every neuron of both layers consists of an equal number of weights to the number of classes that have to be modeled.

Second Methods used in that research was XY-fused networks (XY-F) [10]. XY-fused Networks (XY-Fs) [12] are regarded as supervised neural networks capable of forming classification models that are resulting from SOMs. In these networks, the winning neuron is determined by estimating the Euclidean distances between (a) the data sample (xi) and the weights of the Kohonen layer, (b) the class membership vector (ci) and the weights of the output layer. Then, these two Euclidean distances are joined together to create a fused similarity, which is utilized for the winning neuron indication.

Third Methods used in that research was Supervised Kohonen networks (SKNs) [10]. Similarly to CP-ANNs and XY-Fs, the Supervised Kohonen Networks (SKNs) models [12] are considered as supervised neural networks, derived from SOMs and are utilized for classification models estimation. In the case of SKNs, the Kohonen and output layers are joined together to bring up a combined layer that is updated taking into account the training regime of SOMs. Every sample (xi) and its related class vector (ci) are associated and form an input for the network. The xi and ci must be scaled properly for constructing classification models with good predictive performances. Hence, a scaling coefficient for ci is proposed aiming at tuning the class vector influence in the model calculation.

In that research Soil Data Collected by VIS-NIR Sensor and the values of the eight soil parameters collected in 2013 with the on-line soil sensor (pH, MC, TN, TC, Mg, Ca, CEC and available P).

In that research, three SOM based models, namely, supervised Kohonen networks (SKN), counter-propagation artificial networks (CP-ANN) and XY-fusion (XY-F), which use Supervised Learning to associate high resolution data on soil and crop with isofrequency classes of wheat yield productivity. The best overall results were obtained from the SKN network for the prediction of the low category of wheat yield with a correct classification reached 91.3% for both cross validation and independent validation.

4. MEASUREMENT OF PLANT-HEIGHT

In recent years different techniques were used for measurement of Plant Height. One of this research is Measurement and Calibration of Plant-Height from Fixed-Wing UAV Images [13]. Study Area for that research is Texas A&M AgriLife Research's Farm, TX in USA, That research Estimate Plant height for Sorghum.

Ground-truth height (m) measurements were recorded manually with a meter stick. For plants that had not yet emerged from the early vegetative stage (whorl), measurements were taken from the ground vertically to the apex (highest point) of the plant (Figure 2a). For plants that had reached a reproductive stage, measurements were taken from the ground near the stalk and followed to the tip of the panicle (Figure 2b). Both measurements were essentially considered to be apex measurements [13]. Input Image using Fixed wing unmanned aerial vehicle (UAV). Images collected on each date were mosaicked in PhotoScan Professional 1.3.1 (Agisoft LLC,St. Petersburg, Russia) software and a DSM was calculated with SfM involving interpolation of 3D point clouds.

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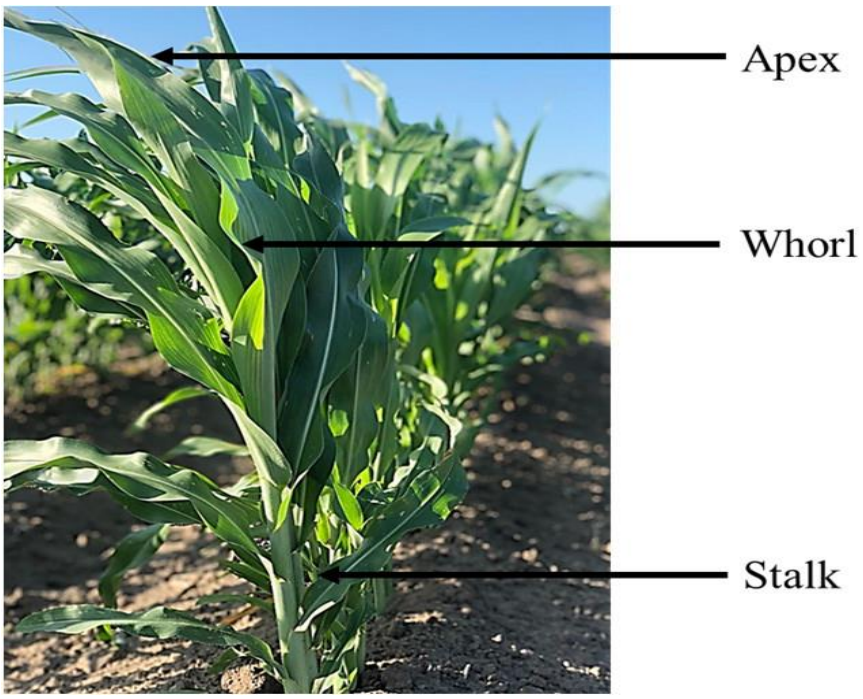

Fig 2. Ground truth measurement of plant height at Vegetative stage. [13]

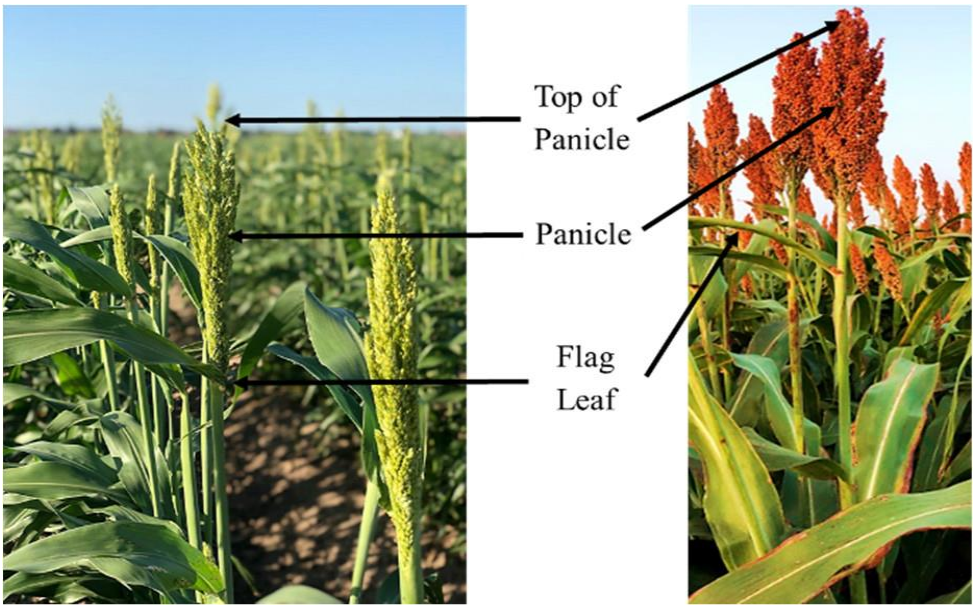

Fig 3. Ground truth measurement of plant height at Reproductive stage. [13]

CONCLUSION

This paper surveys various machine learning algorithms like BPNN, DT, KNN, GPR, CP-ANN, XY-F, SKN. Today each and every person is using machine learning techniques for many purposes. So, in this paper we performed literature survey on Yield prediction with different machine learning algorithms and how to perform Measurement and Calibration of Plant-Height.

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