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Study of Revolutionary use of Machine Learning and IoT based Model in Agricultural Sector: A Review

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ABSTRACT
In traditional ways, understanding the situation of the crop is not that much easy to detect and prevent the diseases in the crop. The availability of skill full farmers and manpower is less. Farmers still have insufficient knowledge and awareness of available latest technologies to facilitate fast and effective management of crops, parameters like soil health, effect of weather condition, water management, species management, yield prediction, crop recommendation, use of fertilizers etc. Now a days Machine learning model is widely used to predict the accuracy of the result. This article aims to provide information of different machine learning approaches proposed to study soil health and crop predictions with its advantages in agriculture sector of India in last decade.
Keywords— Machine Learning, Agricultural sector, Training methods, Testing methods

1. Introduction

Moving with digital era, each and every sector is adapting technological improvements for its progress. As India is an agricultural country, agriculture sector plays very important role in economy of India globally. It is now necessary to adapt technology in agricultural sectors so as to improve yield and productivity of crops with automating the work done for the crop, minimizing the manpower, detecting and managing diseases on initial stages [1] .Machine learning in agriculture implemented with different crops from sowing to harvesting it. Many techniques from different technologies like big data, artificial intelligence, drones and data mining are used for mapping with existing data to identify and fix the solution of frequent problems. Agriculture in traditional farming faces of many problems like, less manpower, inadequate knowledge of soil health, disease identification in early stages of crops usage of appropriate pesticides. Manually it is too difficult to know all about the crops and crop types as uncertainty in environmental condition and soil management. These consequences lead to the less yield with high expenditure on crops

Machine learning approaches in agriculture are basically divided in to two steps-training and testing. The combined mechanism of Deep learning and artificial intelligence is used to train then system and to automate the system respectively. Machine learning approach in agriculture mainly uses existing dataset available on various farming portals mapping with new dataset collected by sensors, image processing equipment etc.

2. Literature survey

The author of [3] suggested crop based on soil classification with assembling classifiers system has been developed after examining several previous systems on crop prediction. The Artificial Neural Network (ANN) algorithms are used. to improve the accuracy of the framework that generates a list of suitable crops based on the soil type. Another author [4] preferred Convolutional Neural Networks

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(CNN) with symmetrical architectures gave significantly better results for image classification for the selected soil classification dataset. this system is adapted to a mixture of soil types, by accounting for the composition present in the minority of the mixture. Another authors [5] proposed the system that uses supervised Machine learning algorithms like Linear Regression Multi-Variate, Support Vector Machine, Random Forest Classifier and gives best result based on error analysis. Author [6] proposed system for prediction of soil quality using data mining approach with the high accuracy level as compared to hardware-based solutions, because components like soil composition, soil type, pH value, weather conditions all come into picture during the prediction process. This proposed system uses unsupervised and supervised learning algorithms, like Kohonen Self Organizing Map (Kohenon's SOM) and BPN (Back Propagation Network) for precise and accurate in predicting crops, the project analyses the nutrients present in the soil and the crop productivity based on location. The results of the two algorithms will be compared and the one giving the best and accurate output will be selected. Thus, the system will help reduce the difficulties faced by the farmers and stop them from attempting suicides. Next author [7] emphasises the classification of soil based on the test report to a number of features with fertility indices for boron (B), organic carbon (OC), potassium (K), phosphorus (P), and available boron (B), along with the parameter soil reaction (pH).the system uses a extreme Learning Method (ELM) for a fast learning classification which is trained using the data to identify the micronutrients present in the soil. The author [9] proposed system that helps in determining the best crop yield and suitable fertilizers to be used. Also, it helps to determine the diseases that plants are affected with. The reference papers appeared in standard journals with high cited papers and many are the reputed papers with implemented on all over the world on machine learning in agriculture. The author [10] proposed the method that illustrates how a machine learning model predicts whether the soil is healthy or unhealthy for crops. In this system total five algorithms are used- Logistic regression is the most basic type of algorithm used for classification. It makes the classification based on probability. The sigmoid function is the loss function used by logistic. Support Vector Machine (SVM) is most widely used for classifying data. Decision Trees are a predictive modelling approach that divides data into different conditions in the form of a tree. The Random Forest Classifier, XGBoost Classifier is another DT classification method that uses gradient boosting to improve prediction efficiency.

3. Machine Learning Algorithm in Soil Analysis

Prediction of soil health and fertility is the prior and the most crucial step which influences the selection of crop, land preparation, selection of seed, crop yield, and selection of fertilizers/manure. The soil health is directly related to the geographic and climatic conditions of the land in use and hence is an important factor to take into consideration. The soil health prediction mostly consists of predicting nutrients in the soil, soil surface humidity, weather conditions that are getting affected during the lifecycle of the crop. Traditionally, it is very expensive and hectic to find out and predict soil health by every cycle of crop with inaccurate dataset. Now a days many machine learning mechanisms and AI based approaches are proposed in farming to find soil fertility and health, prediction of type of crop, water management, disease detection and selection of pesticide with existing patterns, crop management. Machine learning is the emerging domain of computer engineering area that is use to accomplish a precise task without using clear-cut information for finding some pattern in the big data set. it is based on scientific, logical facts and algorithms also have statistical calculus models. Machine learning consists of five major components. These five major components are-

1). Collecting data from the farm 2). Data storage 3). Data pre-processing 4). Train the model and 5). Performance metrics.

SVM and its variants are the most preferred method in many agricultural applications due to its significant accuracy with less computation power. Also, SVM is useful for both regression and classification tasks RF is the second-highest supervised ML technique used for soil analysis and prediction applications. RF builds multiple decision trees and merges them to get a more accurate and

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stable prediction. The tree-based models (TBM), like decision trees (DT), are instrumental in predicting and classifying the different properties and soil types. DT helps in establishing the relationship between various parameters of agricultural soils. In DT analysis, observations enter at the root node, and a iterative test is applied to differentiate the measurements into best classes, making groups cleaner. This process of testing and splitting the observations into classes continues till it reaches a terminal node. DT with fewer elements on terminal nodes yields higher accuracy, and reduced ' precision of prediction.

Table. 1. Machine Learning algorithms and AI based models used effectively in Agriculture.

ML And AI Algorithm	Descriptions
Support Vector Machine or SVM	Supervised Learning algorithms, which is used for Classification as well as Regression problems
Random Forest Regression	supervised learning algorithm that uses ensemble learning method for regression.
Logistic Regression	Supervised Learning technique. It is used for predicting the categorical dependent variable using a given set of independent variables.
Decision Tree	Supervised learning technique that can be used for both classification and Regression problems, but mostly it is preferred for solving Classification problems
RNN	Forward artificial neural network with feedback from the output layers of neurons to the input layer. This network consists of self-loop.
ELM	Feedforward neural network with single or multiple layers of neurons. It is a non-iterative approach useful for real-time regression and classification problems.
CNN	Most widely used neural network. This network consists of number of neuron layers in which network use mathematical operation convolution instead of matrix multiplication in at least one layer of network
MLP NN	It is a feedforward artificial Neural network used for biological dataset.

RF is the second-highest supervised ML technique used for soil analysis and prediction applications. RF builds multiple decision trees and merges them to get a more accurate and stable prediction. The tree-based models (TBM), like decision trees (DT), are instrumental in predicting and classifying the different properties and soil types. DT helps in establishing the relationship between various parameters of agricultural soils. In DT analysis, observations enter at the root node, and a iterative test is applied to differentiate the measurements into best classes, making groups cleaner. This process of testing and splitting the observations into classes continues till it reaches a terminal node. DT with fewer elements on terminal nodes yields higher accuracy, and reduced ' precision of prediction. ML technique distribution graphically across the number of research papers written to predict soil parameters and soil physiochemical properties, respectively, for soil health management (SHM). As per the review of research papers SVM is the top contributor for predicting soil parameters', ANN, BPNN, PLSR, MLSR are the next highest contributor to various prediction models. The prediction of physiochemical soil properties is explicitly considered, then RF and ANN come out to equally excellent and top contributors.TM or TBM and MLR are the next highest contributors to estimate chemical and physical soil properties of soil.

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According to the review of several research papers -a) For the prediction of soil parameters for SHM, most used ML methods are SVM and Random Forest. b) SVM and BPNN are preferred methods for estimation of soil nutrients. c) Regression-based models are the top approaches used for ML based analysis in soil health management applications

CONCLUSION

As India is an agricultural country, global economy is depending upon the agricultural yield which is mostly rely soil health and fertility In this paper, authors have reviewed a brief introduction to ML algorithms which are most commonly used in precision agriculture basically in soil health prediction. DL algorithms such as CNN and ML classification algorithms such as SVM, Decision trees, and RF and Regression algorithms for soil properties prediction. SVM and RF is most widely used and Machin learning classification algorithm with highest accuracy in soil health prediction.

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