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A Novel Machine Learning Framework for Agriculutral Productivity using Multi Valued Datasets

S Lavanya Reddy, Swathi C, Akanksh Reddy Muddam

Asst. Professor, Computer Science Department, St. Joseph's Degree and PG College, Hyderabad.
Asst. Professor, Computer Science Department, St. Joseph's Degree and PG College, Hyderabad.
CSE Department, Sree Dattha institute of Engineering and Science, Hyderabad.

Abstract-In the field of agriculture, the accurate estimation of yield production is crucial for farmers and Govt. Remote sensing plays an important role which collects data from the field level, that is been deployed in the contemporary farming system for building decision-making tool, which can predict accurate yield production and other field level parameters by minimizing operation cost. Changes in ecological factors, for example, water quality, soil quality, and contamination factors lead to illnesses in food creating plants. Distinguishing plant illness is a truly challenging errand in horticulture. Plant illnesses are likewise for the most part brought about by many impacts in farming which incorporates crossover hereditary qualities, and the plant lifetime during the disease, ecological changes like climatic changes, soil, temperature, downpour, wind, climate and so forth. The diseases might be single or blended, as indicated by the contaminations the plants illnesses spread. Early identification of plant sicknesses utilizing later advances helps the plants development. Consequently, ML strategies are utilized for right on time forecast of the illnesses. This paper is utilized to work on the exactness of distinguishing plant sicknesses utilizing
the expectation of the dirt substance in the field land. In the modern era, many purposes behind agricultural plant illness because of horrible atmospheric conditions. Many reasons that impact illness in rural plants incorporate assortment/mixture hereditary qualities, the lifetime of plants at the hour of disease, climate (soil, environment), climate (temperature, wind, downpour, hail, and so on), single versus blended contaminations, and hereditary qualities of the microorganism populaces. This paper is used to improve the accuracy of detecting plant diseases using the prediction of the soil content in the field land. Because of these elements, finding of plant infections at the beginning phases can be a troublesome errand. Machine Learning (ML) classification techniques such as Naïve Bayes (NB) and Neural Network (NN) techniques were compared to develop a novel technique to improve the level of accuracy.

Keywords: Classification, machine learning, neural networks, logistic regression, Naïve Bayes, neural networks, supervised machine learning.

I.INTRODUCTION

India is the place that is known for development. Above 70% of individuals, occupations are relying upon development. As the number of inhabitants in India has been expanding continually, a corresponding ascent in the creation of food should be achieved. Weather pattern, soil quality, manure the executives are not many elements for agribusiness, where ranchers utilize their experience to detect and carry out in cultivating to get their yield. It is mistaken in light of continuous environmental change. Remembering, further developing harvest yield creation and quality by limiting the expense of activity and climate is a vital objective in horticulture. The likely development and yield rely upon a wide range of horticultural traits, for example, soil property, climate, land size, water system, and compost the executives. Detecting those variables eventually and precisely is turned into a need in agribusiness. The ground-based vehicle, satellite, airplane, radiometer, and so on are utilized for gathering data for detecting inputs.

Information digging gives huge advantages to dynamic in light of agribusiness. The innovation field of information mining has acquired a seriously extraordinary arrangement of inclusion. It is troublesome, in any case, to manage exceptionally enormous informational collections with a few credits. Here, refined measurable examination is utilized by horticultural field specialists. Information mining procedures broaden the abilities and help as an open-wellspring of information handling for agribusiness [1]. It likewise gives a client situated way to deal with distinguish new and secret realities in datasets of horticulture. By utilizing this private data, agrarian managers can expand the nature of plants. One of the critical information mining applications includes foreseeing the advancement of the plant from the information given. Information digging for farming aides in distinguishing connections among highlights and private data in the datasets for horticulture. This likewise contributes significant query items for useful establishing in horticulture. The extraction of fundamental list items from these datasets brings about the revelation of decides that can be utilized in plant development. Here, the preparation dataset incorporates both the immaterial and monotonous elements that yield less exact outcomes. During pre-handling, the component extraction technique is utilized to diminish the dimensionality of amounts of information. This interaction is to kill unimportant information also, increment exactness and further develop understandability.

Creators are required fundamental requirements for each living being which are satisfied by farming practice. Individuals' lives rely upon farming. Farming gives food and unrefined substances to all individuals in the country. Agrarian individuals endure with many issues like diminished efficiency, unsound plant development, different soil dampness, which are viewed as the primary justification behind this diminished efficiency. It plays a enormous part in horticulture. Because of climatic condition transforms, it prompts shortage of food and everything. To further develop the agribusiness creation, numerous techniques were executed. In horticulture, Information mining is one of the new methodologies. Information mining gives fundamental advantages in going with choice on agrarian information. The information mining gains wide information inclusion. Notwithstanding, the huge informational indexes are challenging to handle with various number of ascribes. Because of above issues, agrarian examination requires progressed factual information by master board of trustees. As of late progression in Information mining procedures help to fabricate a clever information handling in farming field [1]. To recognize realities in horticultural datasets, a user centric approach is proposed to clients. To create the rural nature of plants, administrators use secret data. To anticipate the development of the horticultural plant, information mining techniques were utilized. Information mining distinguishes the connection between the plant's qualities and the data in the datasets. In this way, it gives a useful planting in the agribusiness field. From the datasets, it disposes of every one of the superfluous information and boosts the precision.

II.RELATED WORK

Reads up have been finished for assessing different vegetation properties by utilizing remote detecting at noticeable and close infrared frequencies. This attention on the chlorophylls and other photosynthetic sums. Xue and Su [11] assessed as of late in excess of 100 vegetation records alongside their current circumstance, representativeness, pertinence, and execution accuracy. They confirmed that the use of any ongoing vegetation lists needs careful regard for the qualities and shortcomings of those files and the unequivocal climate for genuine applications where they will be rehearsed. Jaafar and Ahmad [2] and numerous others have been attempted to make crop yield forecasts by executing somewhat detected vegetation lists.

Late exploration works are going on remote detecting strategy which is applied on a few yield animal types like maize [3], trees[4], wheat [5], and rice, wheat, maize [6]. Also, numerous different works have been finished on Dad errands, for example, weed mapping[7], assessing crop water and nitrogen status [8], evaluating evapotranspiration and dry spell pressure [9], and planning of soil properties [10].

The work commitment is:
1. Soil content forecast utilizing calculated relapse in Lengthy Momentary Memory Organization (LSTM).
2. Then, the anticipated information is prepared and tried utilizing a counterfeit brain organization.
3. The expectation of illnesses is done two times, first in calculated relapse procedure and also in fake brain organization.

The horticulture area is confronting difficulties of delivering more to take care of the interest for food in view of the populace with diminishing ecological debasement, the utilization of normal assets, and adjusting to change of environment. Savvy horticulture is an answer, sensor information are gathered, chose, and broke down utilizing ML procedures to tackle different farming issues, exact yield forecast, seeds determination, infection recognition, manures use, and so on. Hassina [5] has done a survey in the act of Information Mining on brilliant farming.

Analysts have created and utilized unique techniques to build the viability and precision of late procedures. Every strategy has explicit shortcomings for anticipating plant sicknesses, for example, offering a specific grouping model with prognostic power, low creation proficiency with
expanded information volume and best consistency. Essentially, because of result creation with an excessive number of misleading up-sides, most strategies are not appropriate for genuine climate. A bogus positive demonstrates a misleading recognizable proof of calculation utilized for order.

From many base papers we came to realize that Brain Organizations, Choice Tree are the most involved calculations for these models. Choice tree utilizes boundaries like greatest profundity and n-assessors, so that by changing those boundaries, we can come by improved results. After research, we have presumed that gathering of Choice tree regressor and AdaBoost regressor gave significant precision. Crop yield expectation subsumes forecast of the yield of the harvest from previously information. At last, this procedure provides us with a suggestion of which harvest ought to be developed in view of the climate states of the field area [2]. Factors like ph, dampness, precipitation, temperature, etc are remembered for the dataset.

During preparing, an immense number of choice trees are shaped, and the result or result is parted into classes in light of the quantity of classes. A Choice Tree Classifier is likewise utilized in this review to look at the two and select the best decision. Directed Learning strategies were utilized to foresee the result. For preparing the model, Irregular Woodland has been contrasted and Choice tree. Crop creation utilizing one of the most utilized boo sting strategies was presented [3]. They assessed two helping calculations: AdaBoost and Inclination Lift. The objective of utilizing a helping calculation is to build an unfortunate student's exhibition with the goal that an improved result might be created. The outcomes demonstrated that the AdaBoost Regressor with Choice Tree has 94.67 percent precision contrasted with 94.9 percent for the AdaBoost Regressor with Arbitrary Timberland. An investigation of the writing on machine learning models for anticipating rural efficiency utilizing meteorological information was introduced [4].

An original framework known as extensible Harvest Yield expectation system is worked for accuracy horticulture utilizing information mining strategies. In this paper there is an examination of necessity for crop yield expectation and unique frameworks have been used lastly it brings about a system which is adaptable for expectation precision [1].

As per the report, expansion of the pursuit to incorporate extra harvest yield-related boundaries. Precipitation, temperature, and soil richness were among the issues tended to. While contrasting the exploratory qualities and results for the harvest paddy dataset, the de ep support learning model is displayed to foresee the information with a 93.7 percent higher exactness and accuracy than the different techniques tried. A classifier-based crop proposal framework was presented [6]. The "Choice Tree" and "KNN" ML characterization calculations were analyzed in this review. Soil boundaries, climatic boundaries, what's more, creation boundaries make up the informational index. This study utilizes AI techniques to ascertain. This paper analyzed the two techniques independently, yet didn't consolidate them. [5].

This model purposes essential characterization, strategies like the arbitrary backwoods, k-NN, strategic relapse, choice tree, XGBoost, SVM and inclination helping classifier for deciding the most appropriate yield and relapse calculations like Direct Relapse, k-NN, DBSCAN, Irregular Woods and ANN calculation to appraise the yield of the most ideal harvest recognized before [8]. To know the regiospecific crop yield investigation and it is handled by carrying out by arbitrary timberland calculation. In this task have picked dataset which in .csv design. For the preparation reason 80% of information is utilized and staying 20% of information is utilized for testing. After the effective preparation and testing subsequent stage is tracking down the precision of the model. We have accomplished a decent exactness which implies this model is great for foreseeing yield [9]. The work process can be utilized to run repeatable investigations (for example early season or end of season forecasts) utilizing standard information to get reproducible results.[10] The outcomes act as a beginning stage for additional improvements. For our situation studies, we anticipated yield at provincial level for five harvests (delicate wheat, spring grain, sunflower, sugar beet, potatoes).

Existing Algorithms	Accuracy
AdaBoost Regressor with Decision Tree	96.12%
AdaBoost Regressor with Random Forest Classifier	95.8%
Bagging with KNN classifiers	89%
Decision tree with Gradient Boosting	94%
Decision tree with Random Forest Regressor	93%

Table.1. Predictions of the proposed Algorithms

III. PROPOSED APPROACH

Utilizing Regulated Learning draws near, ML calculations can figure an objective/result in a assortment of determining regions. In any case, in light of the fact that their review incorporates no calculations, it can't give a clear image of the proposed work's achievability. The Irregular Woods technique develops choice trees on particular information tests, predicts information from every subset, and afterward offers the framework a superior response through casting a ballot. The information was prepared with Arbitrary Backwoods utilizing the sacking approach. To further develop precision, randomization should be embedded in a way that limits connection while saving strength. They can convey an exactness of 95.7 percent.

We develop crop expectation using a productive calculation in the proposed framework. The main job is to make a successful model for foreseeing a superior yield. We apply AI techniques in these tasks, which are basically cross breed arrangement/group models. A troupe of models got from calculated relapse, lDA, Choice tree, SVM, Irregular Timberland, and KNN are utilized in our exploration. This can further develop exactness and give a more exact expectation framework

IV. FRAMEWORK

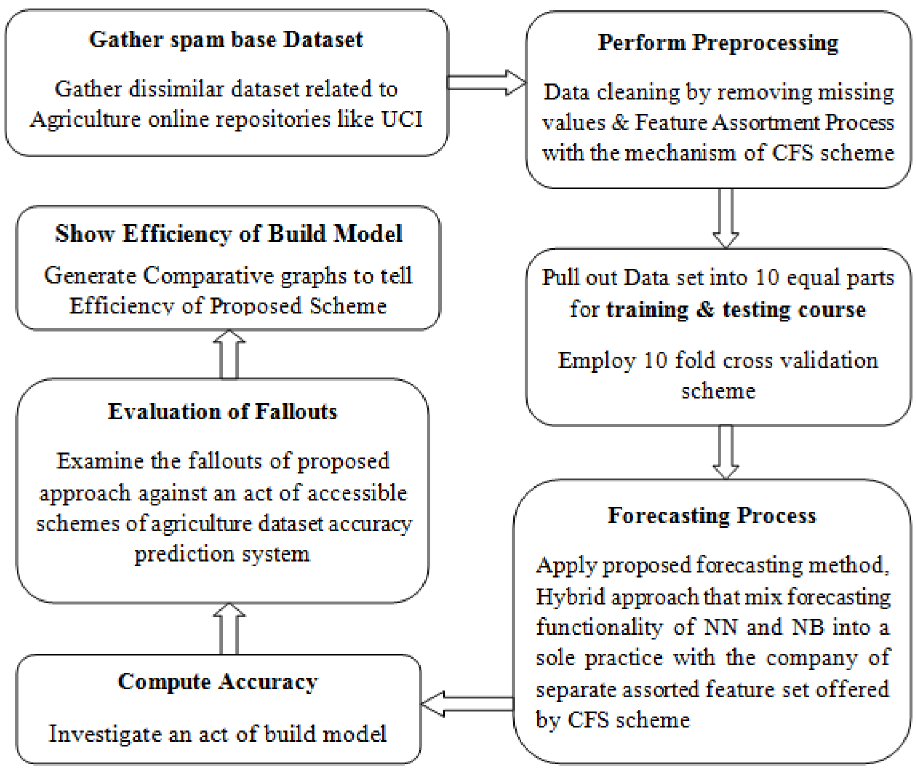
As a worked on variant of the Bayes hypothesis, the Guileless Bayes calculation decides from which class capability has a place . Back probabilities of each highlight, give the upsides of the component present in occurrence; the class with greatest likelihood is designated to the occurrence. A few scientists have executed an enormous number of calculations with misleading problems to build the expectation precision of farming stage infections, yet each accessible calculation has specific limits. The half breed strategy has thusly been carried out in this exploration utilizing the relationship of normal information mining order methods, Brain Organization and Gullible Bayes with the inspiration from past examination that most scientists have tracked down brain network method for producing viable expectation framework. Chosen procedures are implanted in a layered structure to help the precision proportion, where in the event that one strategy neglects to precisely foresee data, the subsequent procedure works on the likelihood of right prediction.[9] The Pseudo periods of the recommended arrangement are as per the following.

The existing prediction system uses classification and single prediction method to improve the accuracy of detecting the plant growth. The diseases in the plant stop the growth of the plant. It only implies the growth of the plant. The plant growth depends on various factors like soil, climatic conditions, and water. In the proposed system, logistic regression with LSTM in neural networks, gives classification and prediction methods. Therefore, the growth of the plant and soil content is also improved in the proposed system.

Algorithmical Approach

1. Insert Agriculture dataset of soybean, eucalyptus, squash and white-clover from UCI repository.
2. Process the preprocessing technique,
  i. 10-Fold cross-validation technique for dividing the dataset into testing and training section.
  ii. Employ CFS with the BFS method for selecting an optimized feature set [1].
3. Investigate data with the prediction mechanism of the Naïve Bayes method.
4. When data predicted accurately the dataset updates the removal of its existence from the processed dataset.
5. When data not predicted not accurately then provide to the next technique i.e. for prediction use MLP.
6. Repeat steps 3 to 5 until the complete dataset is analyzed.
7. Forecast the accuracy of the applied method.

Figure 1. Process flow diagrams



Algorithm : NB algorithm
Input: I={1,... K }days
Output: sm(soil moisture) #predicting the soil moisture content#
1. Memory size is initialized and maximizes the episode s
2. Begin the coefficient weights wt
3. Initialize ℏ0 , ℂ0 = 0 of length K
4. For $Ep = 1, \ldots \ldots . Epmax$
5. Sample the mini batch with size 2r
6. For each $t = 1,2 \ldots . . K$
7. Fetch sample for mini batch $It = [aŦ(t), aĦ(t), sm(t), sŦ(t), rL(t)]$ and $Yobs$

8. Calculate the equation
9. Cell memory state is update
10. Calculate equation
11. End for
12. Output: ħ = {ħ1, … . . ħK }
13. Predicted output is calculated
14. Evaluate loss function
15. LSTM weight parameter is updated
16. End for
#Prediction#
17. Examine and collect the environment and information of the land $It = [aŦ(t), aĦ(t), sm(t), sŦ(t), rL(t)]$
18. Input is given into the trained LSTM model
19. Soil moisture content $sm(t + 1)$ *is predicted*
20. The input is stored into the tuple in replay memory set.

The Algorithm 1 shows the proposed method framework. The input values $It = [aŦ(t), aĦ(t), sm(t), sŦ(t), rL(t)]$ are given into the network which is trained for volumetric prediction using soil moisture $sm(t + 1)$ content as of later by one day. The volumetric soil water content prediction using the crop data (root growth) and soil data for estimating the irrigation timing and the required amount of water for crop growth is done ultimately.

VI. CROP DISEASE DETECTION

Disease symptoms, namely the physical evidence of the presence of pathogens and the changes in the plants' phenotype, may consist of leaf and fruit spots, wilting and color change [5], curling of leaves, etc. Historically, disease detection was conducted by expert agronomists, by performing field scouting. However, this process is time-consuming and solely based on visual inspection. Recent technological advances have made commercially available sensing systems able to identify diseased plants before the symptoms become visible. Furthermore, in the past few years, computer vision, especially by employing deep learning, has made remarkable progress. As highlighted by Zhang et al. [56], who focused on identifying cucumber leaf diseases by utilizing deep learning, due to the complex environmental background, it is beneficial to eliminate background before model training. Crop diseases constitute a major threat in agricultural production systems that deteriorate yield quality and quantity at production, storage, and transportation level. At farm level, reports on yield losses, due to plant diseases, are very common [4]. Furthermore, crop diseases pose significant risks to food security at a global scale. Timely identification of plant diseases is a key aspect for efficient management. Plant diseases may be provoked by various kinds of bacteria, fungi, pests, viruses, and other agents. Moreover, accurate image classifiers for disease diagnosis need a large dataset of both healthy and diseased plant images. In reference to large-scale cultivations, such kinds of automated processes can be combined with autonomous vehicles, to timely identify Phyto pathological problems by implementing regular inspections. Furthermore, maps of the spatial distribution of the plant disease can be created, depicting the zones in the farm where the infection has been spread [7].

VII. EXPERIMENTAL ANALYSIS

The proposed approach has been carried out using the same criteria as the use of different conventional methodologies to find an efficient and balanced contrast based on prediction accuracy. Depending on its prediction accuracy, the entire algorithms, i.e. the proposed and single prediction technique, were analyzed. This section examines the experimental results of the implemented model. The new decision-making model can be implemented here, and simulation can be carried out. The tests would have higher accuracy, and the consistency would be more dependable. Therefore, the overall success of the approach proposed in this section shall be measured. The outcomes and viability of the suggested solution are calculated and contrasted with the parameters of the calculation.

Algorithm: Pseudocode for the Classification Process
Input: Enhanced data
Output: filtered data
Initialize the DBN layers
Initialize the vgg layers
Integrated DBN layers and vgg layers
Initialize train features
Initialize label
Train label = 80%
Test label = 20%
Lab = unique(label)
For ii = 1:lengh(Lab)
Class = find(label == Lab (ii))
To pass trainfeatures data to each layers,
Traincut = length(class) * traincut
Traindata = [traindata; trainfeatures;class(1: Traincut)end-5:end]
Predict label = classify(net,traindata)
End
End
For ii = 1:size(traindata,1)
Traindata = [traindata; trainfeatures;class(1: Traincut)end-5:end]
End
For ii = 1:size(trainfea,1)
Testdata = [trainfea; trainfeatures;class(1: Traincut)end-5:end]
End

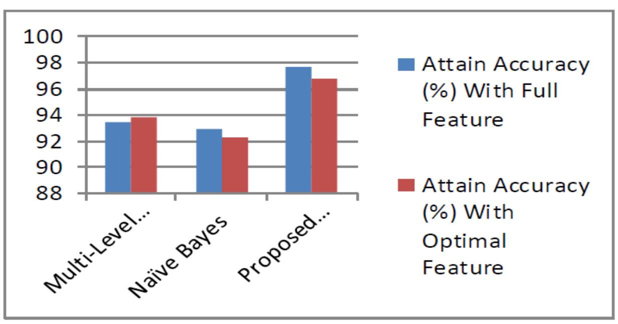


Figure 4 Proposed Approach, NB &MLP Mechanism

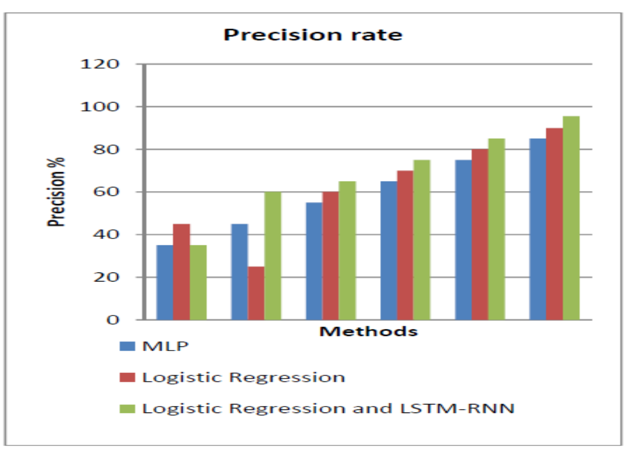


Figure3. Precision rate results

Several experiments have been performed with the same parameters for comparison between implemented technique and other used data prediction algorithm results, using the similar datasets with required parameters, like number of attributes & no of instances. A variety of datasets were obtained from the online data provider that is the UCI repository for further assessment.

Performance Aspects

Accuracy

This is a plot of organized errors, a predisposition measure; poor accuracy produces a difference between an outcome and a true value. In certain instances, data are checked with the same method, and the exact performance of the implemented model is evaluated. The quality of the overall data is the percentage of actual outcomes (both positive and negative).

$$\text{Accuracy (A)} = (TP + TN)/(TP + TN + FP + FN)$$

Precision

Precision is a portrayal of random errors that is a measure of algebraic variability.

$$\text{Precision} = TP/(TP + FP) \quad (26)$$

Recall

Recall in certain fields calculates the proportion of positive facts and correctly defines the true optimistic rate, warning, or probability of identification.

$$\text{Sensitivity} = TP/(TP + FN)$$

Mean square error

This measures the average of the squares of the errors, that is, the average squared difference between the estimated values and the actual value.

$$\text{MSE} = \frac{1}{N} \sum_{i=1}^{N} (x_i - \hat{x}_i)2$$

Dice co-efficient

We assume b and c are the properties of the fundamental truth data and the data characteristics found. Then, we can then determine the Dice coefficient as

$$D(b,c) = (2b \setminus c/a + b) = 2TP/2TP + FN + FP$$

Jaccard co-efficient

The resemblance of the two groups can be calculated as

$$J(b,c) = (b \cap c/bUc) = (b \cap c)/b + c - (b \cap c) = (TP/TP + FN + FP)$$

The findings reveal that the proposed method shows exact, high Jaccard values and the coefficient of dices.

Table 2. Prosed and classical scheme over Soyabean dataset

Fore casting practices	Attain accuracy	
	Full feature	Optimal feature
Multi-Level Perception (MLP)	93.54	93.85
Naïve Bayes	92.45	92.58
Propose Approach	96.58	96.88

Table 3. Proposed and other scheme over Soyabean dataset

Fore casting practices	Attain accuracy
Multi-Level Perception (MLP)	93.54
Naïve Bayes	92.45
Propose Approach	96.58
ANN	95.24
Propose Approach	97.55

The results shown in the above-mentioned table that the proposed method has achieved significantly high predictive accuracy of soybean when compared with conventional single data mining applications but also against one of the modern intended algorithms.

Confusion matrix constitutes one of the most intuitive metrics towards finding the correctness of a model. It is used for classification problems, where the result can be of at least two types of classes. Let us consider a simple example, by giving a label to a target variable: for example, “1” when a plant has been infected with a disease and “0” otherwise. In this simplified case, the confusion matrix is a 2 X 2 table having two dimensions, namely “Actual” and “Predicted”, while its dimensions have the outcome of the comparison between the predictions with the actual class label. Concerning the above simplified example, this outcome can acquire the following values:

True Positive (TP): The plant has a disease (1) and the model classifies this case as diseased (1);
True Negative (TN): The plant does not have a disease (0) and the model classifies this case as a healthy plant (0);
False Positive (FP): The plant does not have a disease (0), but the model classifies this case as diseased (1);
False Negative (FN): The plant has a disease (1), but the model classifies this case as a healthy plant (0).

V. CONCLUSION

In the proposed paper, classification of disease and soil moisture content prediction was conducted for the improvement in the agriculture field. For high yield, the diseases are identified first, and the soil moisture content should be predicted. Therefore, the proposed algorithms were effectively used, and it gives high accuracy level and predicts the soil moisture content i.e., the water level in the soil. In the proposed work, several experiments were conducted for data prediction. The proposed method does not necessarily incorporate these algorithms but also takes into account a selection process for attributes at the time of construction technique. A correlation-based feature selection methodology has been used for the best first search approach to select only relative and effective attributes. The developed technique operates in a layer format in which each layer separately predicts the entity using the optimized feature set chosen by the integrated attribute selection process. A variety of datasets were obtained from the online data pool that is the UCI data repository for the assessment. The feasibility and effectiveness of proposed data prediction of this research was shown in each assessment outcome. With the help of sensors, the soil moisture is predicted, thus the farmer can sprinkle the water whenever they needed. So, the proposed system identifies the diseases of the plant and identifies the soil moisture level in the land. After these predictions, the farmers can give more yields in their land. It reduces the time and workers.

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