International Journal of Modern Agriculture, Volume 9, No.3, 2020
ISSN: 2305-7246

Crop Yield Prediction Using Machine Learning Techniques

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Abstract

Only when crops are managed effectively will the information they provide be turned into profitable decisions. Data has become a vital component of modern agriculture, assisting producers with critical decision-making, and current advances in data management are propelling Smart Farming forward at a breakneck pace. This type of data-driven farm management relies on data to improve productivity while reducing resource waste and pollution of the environment. We offer an agro-market knowledge suggested system based on cloud computing to contribute specific suggestions for farmers. We suggest putting in place a system that informs farmers about the crops that should be planted in a given season, as well as stakeholders about the product's current market price This type of system makes traditional farming practices more accessible to the younger generation. Bidding is difficult, but our proposed system offers the real market rate before informing the user of the current retail rate, preventing farmers from bidding. Agriculture yield forecasts are useful for farm administration and can assist collaborators in executing crucial agreements in their agricultural operation in today's agriculture. Farmers are able to manage all aspects of their farms. Farmers are able to manage all aspects of their farms while keeping an eye on the current market estimate of production. As a result, this type of technique is advantageous to the younger generation.

Keywords: Agro-market, stakeholders, critical decision, agricultural operation, bidding, Role of Machine Learning in Agriculture, Random Forest, K Means Clustering.

I INTRODUCTION

Agriculture accounts for roughly 23% of GDP in India, with 59 percent of the workforce employed. India is the world's second-largest agricultural crop producer. The technical contribution will assist the farmer in increasing his yield. The farmer may be aided in deciding which crop to grow if the yield of different crops can be predicted. [18] Farmers today grow crops based on the knowledge they've gained over the years. Since the customary technique for cultivating is polished there exists an overabundance or shortage of yields without gathering the real necessity. Agriculture is something that individuals have started to finish up moderate on, disregarding that it's miles what is holding us alive. However, there is regardless some driving forward, enthusiastic ranchers whose life continues running on essentially developing[5].Regardless, there's in addition the pollution that is extending packages these days. " The crop cycle data for the summer, Kharif, Rabi, autumn, and the whole year is used. The data was obtained from a website run by the Indian government. Cultivation area, crop, state, district, season, year, and production or yield are the experimental parameters studied". [16].The Main intention of the Department of Agricultural Marketing and Agricultural Business is to have a reasonable cost to the cultivating network who are pushed behind the current focused showcasing situation and the mission of accomplishing the reasonable cost is by making the current demonstration and principles solid and progressively compelling by executing new innovations and systems went for lessening pre and post-gather misfortunes through legitimate and sorted out techniques and urge enhancing the market.

The vital motivation behind making a managed market is to put off the undesirable exchange work out, to diminish the charges inside the commercial center and to offer reasonable expenses to the Farmers. This article retrieves the capability of forecasting yield before the inception of the crop season. This provides the user the efficiency to function scenario transition. Furthermore, statistical models for crop forecasting have been created, which will assist farmers in making timely crop decisions. The agricultural retailing intelligence endorsement structure has been proposed based on cloud computing in order to contribute meticulous recommendations. Ultra-modern technology can also be used for the weather forecasting, crop harvesting and storage, pest production, disease deduction in crops, weed management, plant growth, seed sowing, product selection, agricultural water productivity and finally quality maintenance.

II RELATED WORK

[1]Deepak Murugan has proposed “Precision agriculture monitoring at larger scales is critical for improved agricultural productivity and food management. Drones have been used for precision agricultural monitoring at smaller scales in recent years, and satellite data has been used for land cover classification and agriculture monitoring at higher scales for many decades”. [19]. Satellite-based time-series crop monitoring at the subfield level is required for effective precision crop management implementation. Accurately monitoring agriculture on a large scale is a difficult task. [17].

The classification of sparse and dense fields using freely available satellite data (Landsat 8) and drone data is proposed in this paper as a method for precision agricultural monitoring. Drone usage must be reduced, so an adaptive classification approach is developed that uses image statistics from the chosen area. There is a lot of interest right now in gathering remote sensing data multiple times in order to perform near real-time soil, crop, and pest management. [1]. On various spatial and temporal Landsat 8 data, the proposed approach has been successfully tested and validated.

[2] Jochen Huster has proposed In harvesting technology, cutting processes are among the most important crushing procedures. Trying to figure out when to regrind crop cutting blades is a common practise that rarely yields the desired results. “Continuous monitoring of harvesting machine cutter bars may provide the best regrinding time to maintain cutting performance and, ideally, long maintenance intervals. Based on an analytical simulation, acoustic measurements, and statistical analysis, a method for real-time acoustic monitoring of the sharpness of crop cutting blades is demonstrated in this study”[5].

The signals were captured at a sampling rate of 60 kHz and the measurements were done with piezoelectric accelerometers. Structure-borne sound was measured on a self-propelled field chopper's counter blade, knife drum, and cabin during harvesting [10]. The blade condition and structure-borne sound were found to have a good relationship. The statistical classification analysis with support vector machine had an accuracy of 0.76. (support vector machine) technique allows an attribution of blade sharpness (described by executed grinding cycles). Further development steps and the potential for system component design optimization are also discussed.

[3] Cyrill Stachniss has proposed Precision agriculture requires continuous crop monitoring, which records sensor data for a longer period of time. Fields are tracked with installed cameras and unmanned aerial vehicles (UAVs), but “traditional image registration procedures are challenged by strong changes in the visual appearance of growing crops and the field itself [11]. We present a method for registering images of agricultural areas taken by a UAV during the harvest season, as well as a complete computing pipeline”, in this paper. High-resolution satellite imagery, in particular, is now more widely used to investigate these variations in crop and soil conditions [5]. 3D point of the field that are temporally aligned.

Our strategy takes advantage of crop management's internal role in an area that has remained relatively stable over time. To this end, we propose a scale-based geometric feature descriptor for encoding local plant management geometry. The experiments have shown that we can record images taken during crop season even when a standard visual descriptor fails to match them. We also put our matching system, which is manually labelled Land truth, to the test. The reconstructed 3D models are qualitatively accurate, and the registration results allow for plant-level monitoring of growth parameters, according to the researchers.

[4] R.Carelli has proposed the construction, modelling, and "identification of an autonomous vehicle for agricultural tasks " The goal of various models is to determine the best model structure. It was made public[10]. The horizontal and vertical dynamics, in particular, are separate dynamics, and they are modelled and identified separately based on this assumption. The lateral and rotational dynamics were given special attention. The research vehicle is a quadrilateral (ATV) that has been modified and put into autonomous operation[9]. It provides simulation proofs and real-world experiments to ensure that the developed models perform as expected.

[5]Joan R has proposed " Mobile terrestrial laser scanners (MTLS) are light detection and sensor-based devices used in agricultural applications all over the world. MTLS is used to describe the geometry and structure of plants and crops for technical and scientific purposes" [14]. Regardless of the MTLS' excellent performance, their high cost remains a disadvantage in most agricultural applications. "The Kinect V2 Depth sensor and the Real Time Kinematic Global Navigation Satellite System" (GNSSextended)'s colour information capability are combined in this paper to present a low-cost alternative to MTLS [20]. This system's theoretical foundations are revealed, as well as some experimental results demonstrating its performance and limits. Although the majority of the results can be applied to similar outdoor uses, this study focuses on open field agricultural applications. Users can choose from a variety of options with the Kinect Based RTLS system that has been developed.

III EXISTING SYSTEM

The economic development of an agro-based country is reliant on agriculture. When a country's population grows, so does its reliance on agriculture, and the country's economic growth suffers as a result. In this situation, the crop yield rate has a major impact on the country's economic growth. As a result, crop yield rates must be increased. To solve this problem, some biological approaches (e.g., crop seed quality, crop hybridization, strong pesticides) and some chemical approaches (e.g., fertiliser, urea, potash) are used. A crop sequencing technique, in addition to these methods, is needed to improve the crop's net yield rate over the season. Crop Selection Method (CSM) is one of the existing systems we found for achieving a net yield rate of crops over the season. We used CSM as an example to show how it aids farmers in reaching higher yields. Crops are categorised as:

a) Seasonal crops, "which can be planted at any time during the year" . Wheat and cotton, for example.

b) Whole year crops— " crops that can be planted all year." Example: Toor,

c) Short-duration crops—these are crops that

grow quickly. Potatoes, vegetables, and their proportions, for example. d) Plantation crops that take a long time to grow— These crops take a long time to grow. For example, sugarcane and onion. Based on daily yield rate, a combination of these crops can be chosen in a specific order. Sequences of crops are depicted, along with the cumulative yield rate for the season. The CSM approach, as shown in, would increase the net yield rate of crops when using limited land resources, as well as the land's re-usability.

III MACHINE LEARNING ALGORITHM

3.1 K-MEANS CLUSTERING ALGORITHM

Algorithm of K-Means Clustering is a popular exploratory data analysis method for gaining an understanding of the data's structure. The function of finding subgroups in data can be identified as it. Data points within the same cluster, or subset, are very similar, while data points within different clusters are very different. Because there is no ground truth to compare the clustering algorithm's output to the true labels to determine its performance, clustering is an unsupervised learning technique, unlike supervised learning. We simply want to investigate the data structure by dividing the data points into subgroups. K-means is one of the most commonly used clustering algorithms due to its simplicity.

Fig 3.1.1 K-Means Clustering Algorithm Flow Diagram

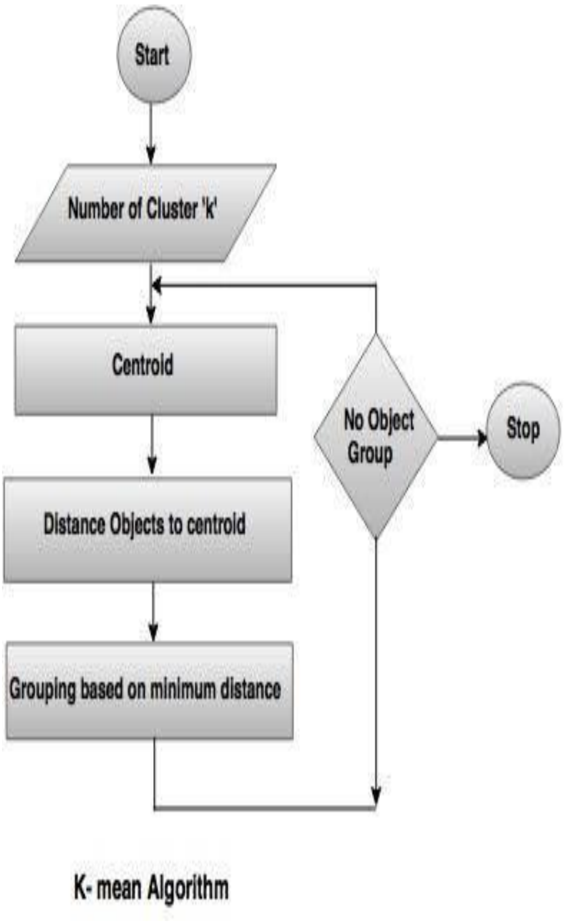
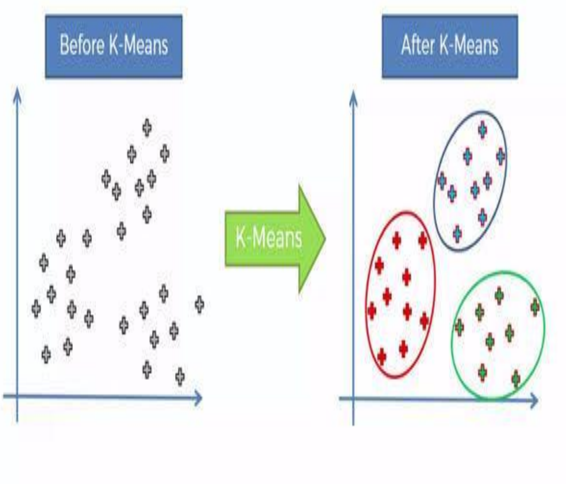


Fig 3.1.2 k-means clustering algorithm



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- Specify the number k of clusters to assign
- Randomly initialize k centroid
- Repeat
- Expectation: assign each points to its closest centroids
- Maximization: compute the new centroid or mean of each cluster
- Until the centroids position do not change

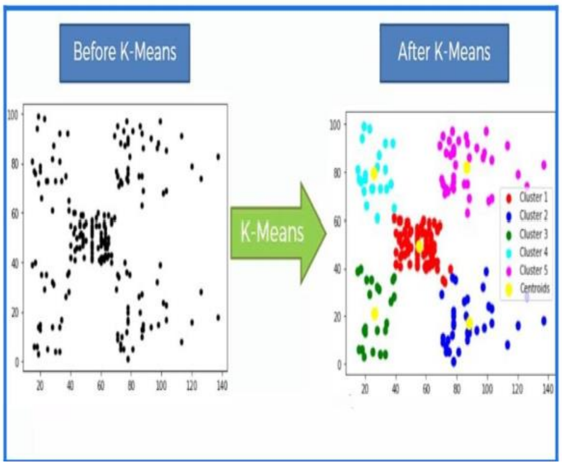

Fig 3.1.3 Example -k-means clustering algorithm

3.2 RANDOM FOREST ALGORITHM

Random forest is a learning algorithm that is supervised. It creates a "forest" out of an ensemble of decision trees, which are normally trained using the "bagging" method. The bagging method's basic premise is that combining different learning models improves the overall result. A random forest is made up of a large number of individual decision trees that work together as an ensemble, as the name suggests. The random forest generates a class prediction for each tree, and the class with the most votes becomes our model's prediction. Random forest has the advantage of being able to solve classification and regression problems, which make up the majority of existing machine learning systems. Because classification is often considered the building block of machine learning, let's look at random forest in classification. As a result, only a random is found in the random forest. The algorithm for dividing a node takes into account a subset of the characteristics. Instead of searching for the best possible thresholds, as a conventional decision tree does, you can make trees even more random by using random thresholds for each feature.

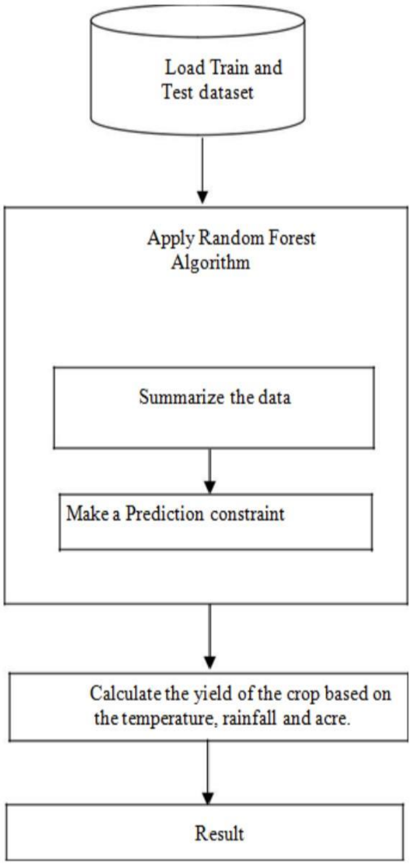

Fig 3.2.1 Random forest algorithm

In an indiscriminate manner select the "**k**" features from the average **"Y"** features.

k<Y

- Among **"k"** features compute the node "**D**" using best split points
- Break the node in to daughter mode using the best split
- Reiterate 1 to 3 steps until I number of nodes has been acquired
- Construct forest by reiterating steps 1 to 4 for "**N**" numbers of times to create **"N"** number of trees.

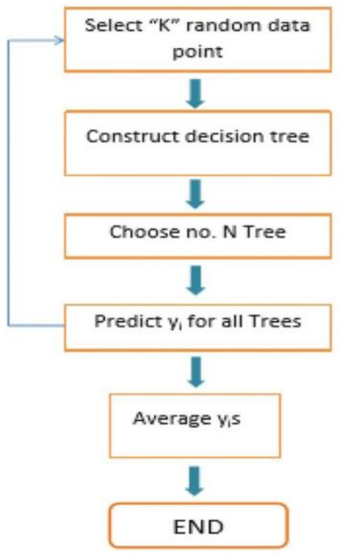

Fig 3.2.2 Random forest algorithm flowchart

IV METHODOLOGY

Farmers can monitor their data using an architectural diagram, and certified advisers can monitor the farmer's agricultural operations and provide guidance on farm status and crop planning. It provides external expertise and decision support to the farmer in order to perform effective field operations. By combining the use of cutting-edge information technology with tried-and-true management methods.

A wide range of services that assist farmers in managing and maintaining control of their farms and crops by assisting with all basic agricultural operations in accordance with a set of good agricultural practices. The learner is not told which action to take at what time; rather, the learner will find which action yields the greatest reward by attempting it on their own, and thus this type of system automatically provides the ability to learn and improve from previous experiences.

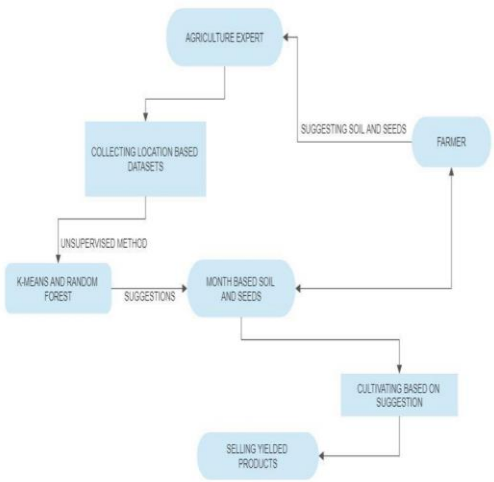

Fig 4 Architecture diagram

B. MODULE DESCRIPTION

4.1 ADMINISTRATOR ENDORSEMENT

The farmer can create an account on the website with their own information such as username, password, contact information, and address information. The administrator will double-check the information and give his or her approval. Only farmers can then log in and submit a question to experts. The farmer may also inquire about fertilizer and other agricultural-related information.

4.2 MONITOR AND MAINTAIN THE CROPS Farmers can now get expert advice on the amount of fertiliser to apply to a specific type of soil and crop through the internet. This will assist them in overcoming the issue of excessive fertiliser use, which is eroding soil health. We created a web-based system that determines the quantity and quality of fertilisers that should be applied to the soil in order to achieve the desired yield. Crop yields can be compared from year to year to assist farmers in making informed decisions about crop management in the future. As a result, record keeping around harvest quantity is critical for farmers who want to track their revenue against their production costs.

4.3 PREDICT AND DETECT PESTS

The farmer may be unaware of the precise price of the crop they sell in the market at any given time. Small farmers sell their produce to local merchants on a regular basis, which can be a useful bargaining tool. Farmers can also decide whether to sell their produce right away or wait based on the information provided by the Expert on current prices. If disease and pest patches inside fields can be detected and handled in a timely manner, disease and pest control will be more effective. This necessitates collecting disease-infected field data as soon as possible and as accurately as possible. As a result, remote sensing offers a quick, cost-effective, and risk-free method of identifying the crop.

4.4 ONLINE COMPUTERIZED AGRI-AUCTION PORTAL

Ensure that farmers receive the best possible price for their produce. Farmers learn about the market demand for the goods they are selling. This will allow them to focus on crops that are in high demand. Finally, farmers can use the agri-auction portal to manage crop price details after the crops have been harvested. Farmers can easily avoid bidding by using this method. Farmers can meet directly with customers using the Online Bidding Application. Farmers can choose their customers based on the price they are willing to pay, i.e. they can choose who to sell their goods to based on the price they are willing to pay.

4.5 FERTILIZER EXPERT SYSTEM

A more practical alternative is to make better use of the land that is currently used for agriculture, though this too has its drawbacks. Agriculture will develop sub-sectors such as seed production, organic fertiliser production, produce aggregation and primary processing, poultry production, and so on. All of this information would be shared with farmers in order to energise the local economy through a multiplier effect based on agricultural land and crop specifics.

C. CROP YIELD FORECAST

Crop production in an agricultural field relies heavily on prediction. Only one method can be used to predict crop growth rates, climatic conditions, crop disease, and so on. This is done through foresight. Reinforcement learning methods can be used to predict. Reinforcement learning takes a hands-on approach to work, attempting it first and then recognizing and correcting errors. We gathered the dataset of all the detailed descriptions of the crops grown using the reinforcement learning approach.

From that data set young generation can also easily get to know the knowledge about the growth details of the crops this prediction method can be used till the end.so without any basic knowledge about the agricultural fields one can easily identify what crop should be sown at which soil,at what season which crop should be grown, within how many days a particular crop should be harvested, whether the land and climate is suitable. Likewise we can collect all our necessary details from the dataset that is predicted already to make a decision. After the crops are harvested we can also enter our crop growth details so that it is helpful for the next year prediction. Information about the harvested crop details can also be collected from the dataset. And hence user knows which crop retrieves the highest cost by simply going through the predicted dataset.

Finally after the crops are harvested, farmers can use the agri-auction portal to manage the price details of the crops.by this method farmers can easily avoid the bidding. From the beginning to till the end without knowing anything about the agricultural field, users can easily get the knowledge about the agriculture and can harvest their farm.

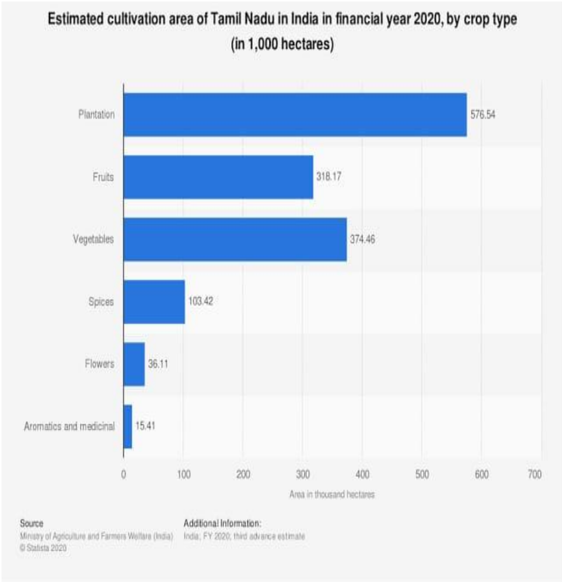

Fig 4.1 graphical representation

V CONCLUSION

This paper presented an examination and a comparison of Agriculture technology advancements are levelling the playing field for small farmers in rural areas. However, the number of people who use such technology is still small. A major challenge is determining what factors promote or inhibit the acceptance and adoption of new information systems. As a result, this concept enables the younger generation to engage in agriculture without the assistance of others.

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