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Smart Farming Application using Machine Learning Algorithm

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Abstract: *The impact of climate change in India has been severe, especially on agricultural crops. Over the last two decades, many crops have seen a drastic decrease in yield, making it difficult for farmers to make a living. This has had a wide-reaching effect on the Indian economy, as agricultural products are a major source of income and employment. As a result, policy makers and farmers are looking for ways to improve the yield of crops. One potential solution is to predict the yield of a crop before it is harvested. With accurate predictions, policy makers and farmers could take appropriate measures for marketing and storage. This would help them to adjust and plan for the changing climate. Technologies such as satellite imaging, remote sensing, and on-site sensors can be used to monitor crop growth and make predictions about yield. Furthermore, the use of weather forecasts, farm management software, and data analysis can be used to optimize crop production. These technologies can provide valuable information about soil and water conditions, pest control, and weather patterns that can help farmers make decisions about when to plant and harvest. In conclusion, climate change is having a serious impact on the performance of agricultural crops in India. In order to increase crop yields, policy makers and farmers must take advantage of new technologies to make predictions and optimize production. As the climate continues to change, making accurate predictions is becoming increasingly important for farmers and agricultural workers. With reliable predictions, farmers can make adjustments to their practices in order to continue to provide for their communities and ensure the safety of their crops. By making adjustments, they can be prepared for the changing weather patterns and other environmental factors, allowing them to better meet the needs of their local population. Agriculture is an essential part of many communities, and with the changing climate, it is important to be able to predict and adjust to the environmental conditions. Accurate predictions provide farmers with the information they need to make the right decisions and take action to protect their crops and communities. This can be achieved through a combination of predictive models, data collection and analysis, and other technologies. By using this combination of tools, farmers can have a better understanding of the changing climate and how it will affect their operations. With this information, they can adjust their practices to better accommodate the changes and improve the lives of everyone involved. This can include taking steps to protect their crops from weather-related damage, improving soil quality and fertility, and reducing the impact of pests and diseases. By making these adjustments, farmers can ensure the success of their operations and that their communities have access to the food, resources, and livelihoods they need. Ultimately, more accurate predictions can help farmers protect their crops, their communities, and the environment*

Keywords: Precision farming

I. INTRODUCTION

Precision farming is an innovative farming technique that uses technology to maximize crop yields while minimizing the use of inputs like fertilizer, water, and pesticides. By leveraging advanced technology, precision farming is able to optimize crop health and maximize yields in a more sustainable manner.

Machine Learning (ML) is a powerful branch of Artificial Intelligence (AI) that allows computers to learn from data without requiring explicit programming. ML algorithms are capable of recognizing patterns in data and making predictions or decisions based on those patterns. This makes it an ideal technology for precision farming, as ML algorithms can be used to analyze data from farm operations and make decisions based on the data. For example, ML algorithms can be used to identify plants that need more water or fertilizer, and to inform farmers when to apply these inputs. In addition, ML algorithms can be used to detect weeds and pests, and to detect crops that require more attention.

Overall, precision farming and ML are two technologies that can be used together to optimize crop health and maximize yields in a more sustainable manner. By leveraging the power of AI and ML, farmers can make more informed decisions about their farming operations and reduce their environmental impact.

Precision farming is a type of agriculture that uses modern technology to better manage resources and increase crop yields. In recent years, the application of machine learning (ML) to precision farming has steadily grown, providing farmers with more efficient and cost-effective ways to optimize their operations. This report presents an overview of precision farming applications that use ML, including their benefits, challenges, and potential future developments.

The use of ML in precision farming allows for more accurate decision-making, which can result in higher yields, improved crop quality, and greater utilization of resources. By utilizing advanced algorithms, ML can help farmers to identify patterns and detect anomalies, enabling them to better predict outcomes and take corrective actions. Additionally, ML can be used to collect data from various sources and analyze it for insights that can be used to improve crop management.

The benefits of ML-powered precision farming are numerous. For example, it can help farmers reduce the amount of water and fertilizer needed for crop production, as well as reduce labor costs. Furthermore, ML can provide farmers with insights into the environmental conditions that affect crop growth, enabling them to adjust their practices accordingly.

Despite these advantages, there are some challenges associated with the use of ML in precision farming. For example, the data used to create predictive models can be biased, which can lead to inaccurate predictions. Additionally, the costs of developing and deploying ML-powered applications can be prohibitive for some farmers.

Looking to the future, there is potential for further development of ML applications in precision farming. For example, the use of computer vision could enable farmers to monitor crop health and detect pests and diseases, while the development of more sophisticated algorithms could lead to the automation of certain farming tasks. Additionally, the use of ML in precision farming could extend beyond the farm, enabling farmers to connect to global markets and optimize their operations.

In conclusion, ML is becoming an increasingly important tool for precision farming, offering numerous benefits and potential for further development. However, there are also challenges associated with its use, which must be addressed in order to maximize its potential.

- Improved Yield: ML can analyze data from multiple sources such as satellite imagery, sensors, and weather stations to help farmers make informed decisions about planting, irrigation, and fertilization. By using ML, farmers can identify the optimal planting time and location, leading to higher crop yields.
- Reduced Cost: By optimizing resource usage, precision farming can reduce the cost of inputs such as fertilizer, water, and pesticides. ML can analyze historical data to identify patterns and provide recommendations that help farmers reduce waste and minimize input costs.
- Environmental Sustainability: Precision farming with ML can help reduce environmental impact by minimizing the use of fertilizers, pesticides, and water. By using ML to analyze data from sensors, farmers can identify areas of their farm that require less irrigation and apply water only where needed, reducing water consumption.
- Challenges of Precision Farming with ML Despite the benefits of precision farming with ML, there are also several challenges:
- Data Availability: The success of ML models depends on the quality and quantity of data available. Precision farming generates vast amounts of data from various sources such as sensors, satellite imagery, and weather stations. However, much of this data may be unstructured or incomplete, making it difficult to use for ML models.

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- Model Accuracy: ML models rely on accurate data to make predictions. However, environmental factors such as weather patterns and soil composition can vary significantly between farms, making it challenging to develop accurate models that work across different locations.
- Technical Expertise: Precision farming with ML requires specialized knowledge and technical expertise. Farmers may require training to understand how to collect and analyze data effectively and how to interpret the results. Future Developments Precision farming with ML is an area of active research and development, and there are several areas of future potential:
- Edge Computing: Edge computing involves processing data close to the source, such as on the farm, rather than sending it to a centralized location. Edge computing can enable real-time data analysis, reducing latency and improving decision-making.
- Automated Decision Making: ML can be used to automate decision-making processes in precision farming. For example, ML models could be used to trigger irrigation systems automatically based on soil moisture levels or to apply pesticides only when necessary.
- Data Integration: Integrating data from multiple sources such as sensors, satellite imagery, and weather stations can provide a more comprehensive view of the farm. ML can be used to analyze this data and provide farmers with insights that are not possible with a single data source.

II. LITERATURE REVIEW

In [1] employing a machine learning algorithm to predict agricultural yield. Engineering Science Research Technology International Journal. This research employs the Random Forest algorithm to forecast the agricultural yield from the available data. The models were constructed using actual data from Tamil Nadu, and they were tested using samples. Using the Random Forest Algorithm, one may predict crop yields with accuracy.

In [2] For the prediction of both global and regional crop yields, see [2]. Journal PLoS ONE. Because of its great accuracy and precision, simplicity of usage, and utility in data analysis, RF is a useful and adaptable machine-learning method for agricultural production projections at regional and global scales. The most effective method is random forest, which exceeds multiple linear regression (MLR).

In [3]. Machine learning-based ensemble model for predicting crop production. The Computer Science and Software Engineering International Journal (IJCSSE). AdaNaive and AdaSVM are the suggested ensemble models in this study that will be used to forecast crop production over a given time frame. AdaSVM and AdaNaive were used in the implementation. SVM and Naive Bayes' efficiency is increased with AdaBoost.

In [4]. The paper presented at the ICCCI conference on computer communication and informatics. In the current study, a user-friendly web page called Crops Advisor was created as a software tool for estimating the impact of meteorological conditions on crop yields.In a few Madhya Pradesh areas, the C4.5 method is utilised to determine the climatic characteristic that has the greatest impact on crop yields of particular crops. The decision tree is used to implement the paper.

In[5]. Crop cultivation prediction. Volume 5, Issue 10, October 2016, of the International Journal for Advanced Research in Computer Science and Electrical and Electronics Engineering (IJARCSEE). The deciphering of soil test findings and soil analysis are currently done on paper. This, in one way or another, has contributed to incorrect interpretation of soil test results, which has led to inaccurate advice of crops, soil amendments, and fertilisers to farmers, resulting in poor crop yields, weaknesses in soil micronutrients, and excessive or sparse fertiliser application. Formulas to Recommend Fertiliser and Match Crops with Soil.

In [6]. IJRET: The article that was published in the international journal for engineering and technology research. The primary goal of this study is to develop a user-friendly interface for farmers that provides an analysis of rice production based on the data that is already accessible. Different data mining approaches were employed to forecast crop yields in order to maximise crop output. such as the K-Means algorithm, which forecasts the atmospheric pollution factor.

In [7]. In October 2016, the Indian Journal of Science and Technology appeared Volume 9(38), DOI:10.17485/ijst/2016/v9i38/95032. An intensified unclear cluster analysis for categorising regions of interest in plants, soil, and residue is offered from GPS-based colour photos. The study provides a number of parameters that can help improve crop productivity and boost the yield ratio during cultivation.

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In [8] In this study, we provide a thorough analysis of the literature on the use of machine learning techniques in agricultural production systems. Together with big data technologies, methods, and high-performance computing, machine learning (ML) has arisen to create new potential for unravelling, quantifying, and analysing data-intensive processes in agricultural operational sectors. Support vector machines (SVP) are used to implement the paper.
In [9]. The study of crop insurance yield that use precision farming from an aerial platform. 5th and 6th Floor, Artur Centre, Gokhale Cross Road, Model Colony, Pune, 411016: the campus of Geoinformatics Symbiosis International University. Precision agriculture (PA) involves the use of remote sensors and geospatial approaches to detect field differences and address them in different manners. In an agricultural field, crop stress, irrigation techniques, the presence of pests and diseases, among other factors, may be the cause of crop growth variability. In order to implement the paper, ensemble learning (EL) was used.
In [10]. Institute on the Environment, University of Minnesota, St. Paul, MN 55108, USA. Random Forests for Global and Regional Crop Yield Predictions. Due to its great accuracy, the resulting outputs demonstrate that RF is a useful and unique machine-learning method for agricultural yield projections at both the regional and global levels. The paper uses a combination of support vector regression (SVG) and k-nearest neighbour algorithms.

III. METHODOLOGY

The most important aspect of every machine learning system is data. We choose to concentrate on the Indian state of Maharashtra for implementing the system. Data collected at the district level were important since local climates vary. To put the system into place, previous knowledge on the crops and climate of a certain area was required.
The data used was taken from many official websites. The information on the crops grown in each Maharashtra district was obtained from www.data.gov.in, and the information on the climate was obtained from www.imd.gov.in. Precipitation, temperature, cloud cover, vapour pressure, and the frequency of rainy days are the climatic factors that have the greatest impact on crop production.
As such, monthly data on these weather-related variables was collected. Dataset collection: In this step, we collect data from various sources and construct datasets. Additionally, both diagnostic and descriptive analytics are being applied to the provided dataset.
Abstracts can be found online in a variety of places, including Data.gov.in and indiastat.org. For a period of not less than ten years, a crop's annual abstracts will be used. Time series with anarchic volatility are frequently allowed in these databases. Both the essential and primary summaries were integrated. Using Random Forests, forecast crop yields on both a regional and global level.
Information Partitioning: the whole collection is split into two halves; for example, 25% of the data are used to test the model, and the remaining 75% is used to train the model. to foresee future occurrences Techniques for Machine Learning (ML) Labelled instances can be used by supervised machine learning algorithms to apply what they have previously learned to new data.
After sufficient education, the system may offer targets for any new input. In order to correctly adapt the model, the learning algorithm may also be able to distinguish between the results and the intended, correct output.
On the other together, unsupervised machine learning methods are used when data used for training is neither tagged nor categorised. Unsupervised learning investigates the methods by which systems can infer a function from unlabeled information in order that represent a hidden structure.
In order to identify hidden structures from unlabeled data, the system does not decide on the right output, but it may study the data and draw conclusions from datasets. Random forest, the most popular and efficient supervised machine learning method, can carry out both classification and regression tasks.
During training, multiple decision trees are created, and the outputs of the class are the mean estimation (for regression) or mode of the classes (for classification) of the individual trees. The more trees there are in a forest, the more realistic the prediction is.

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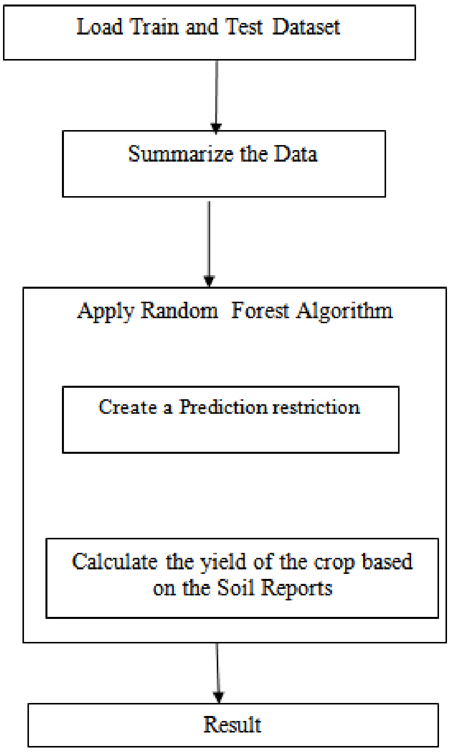

Fig. 1. Proposed Approach

Fig. 1. explains the suggested method, how the data is compiled, how the Random Forest technique is used, and how the outcome is determined.

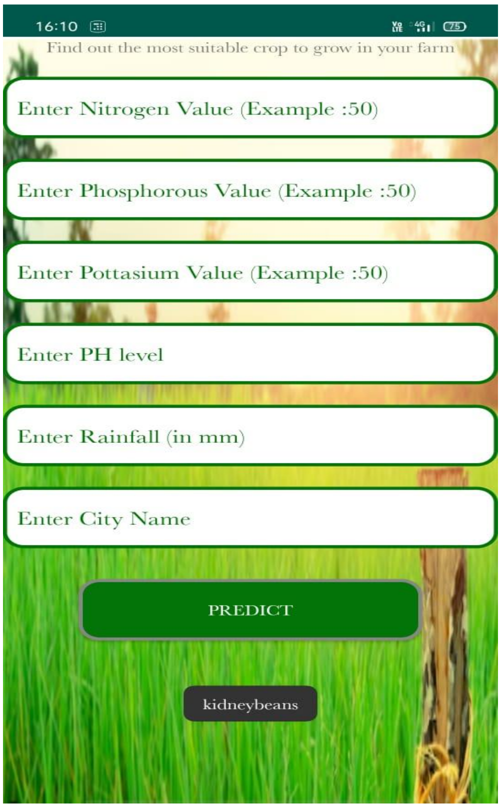

Fig. 2. Home page

Fig. 2 illustrates the website's main page, where visitors enter information such as the district, crop, season, and area in Hectare before clicking on the predicted result icon to print the outcome.

N	P	K	temperatu	humidity	ph	rainfall	label
90	42	43	20.87974	82.00274	6.502985	202.9355	rice
85	58	41	21.77046	80.31964	7.038096	226.6555	rice
60	55	44	23.00446	82.32076	7.840207	263.9642	rice
74	35	40	26.4911	80.15836	6.980401	242.864	rice
78	42	42	20.13017	81.60487	7.628473	262.7173	rice
69	37	42	23.05805	83.37012	7.073454	251.055	rice
69	55	38	22.70884	82.63941	5.700806	271.3249	rice
94	53	40	20.27774	82.89409	5.718627	241.9742	rice
89	54	38	24.51588	83.53522	6.685346	230.4462	rice
68	58	38	23.22397	83.03323	6.336254	221.2092	rice
91	53	40	26.52724	81.41754	5.386168	264.6149	rice
90	46	42	23.97898	81.45062	7.502834	250.0832	rice
78	58	44	26.8008	80.88685	5.108682	284.4365	rice
93	56	36	24.01498	82.05687	6.984354	185.2773	rice
94	50	37	25.66585	80.66385	6.94802	209.587	rice
60	48	39	24.28209	80.30026	7.042299	231.0863	rice
85	38	41	21.58712	82.78837	6.249051	276.6552	rice
91	35	39	23.79392	80.41818	6.97086	206.2612	rice
77	38	36	21.86525	80.1923	5.953933	224.555	rice
88	35	40	23.57944	83.5876	5.853932	291.2987	rice
89	45	36	21.32504	80.47476	6.442475	185.4975	rice
76	40	43	25.15746	83.11713	5.070176	231.3843	rice
67	59	41	21.94767	80.97384	6.012633	213.3561	rice
83	41	43	21.05254	82.6784	6.254028	233.1076	rice
98	47	37	23.48381	81.33265	7.375483	224.0581	rice
66	53	41	25.07564	80.52389	7.778915	257.0039	rice
97	59	43	26.35927	84.04404	6.2865	271.3586	rice
97	50	41	24.52923	80.54499	7.07096	260.2634	rice
60	49	44	20.77576	84.49774	6.244841	240.0811	rice
84	51	35	22.30157	80.64416	6.043305	197.9791	rice
73	57	41	21.44654	84.94376	5.824709	272.2017	rice
92	35	40	22.17932	80.33127	6.357389	200.0883	rice

Fig. 3. Data set

Fig. 3. The data set implemented in the current study is a snapshot of the final processed data collection.

VI. CONCLUSION AND FUTURE SCOPE

The current investigation demonstrated the possible use of data mining approaches in crop production prediction based on the meteorological input factors. The website that was created is easy to use, and all of the crops and study regions that were chosen had predictions that were more than 75% accurate. Any user can utilise the user-friendly website designed for crop yield forecasting by submitting climate data for their preferred crop.

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