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Title **CROP RECOMMENDATION USING MACHINE LEARNING**

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CROP RECOMMENDATION USING MACHINE LEARNING

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ABSTRACT: Agriculture is a major contributor to the Indian economy. The common problem existing among the Indian farmers are they don't choose the right crop based on their soil requirements. Due to this they face a serious setback in productivity. This problem of the farmers has been addressed through precision agriculture. Precision agriculture is a modern farming technique that uses research data of soil characteristics, soil types, crop yield data collection and suggests the farmers the right crop based on their sitespecific parameters. This reduces the wrong choice on a crop and increases the productivity. In this project, we are building an intelligent system, which intends to assist the Indian farmers in making an informed decision about which crop to grow depending on the sowing season, his farm's geographical location and soil characteristics. Further the system will also provide the farmer, the yield prediction if he plants the recommended crop.

Keywords – *Machine Learning, Crop Recommendation.*

1. INTRODUCTION

A farmer's decision about which crop to grow is generally clouded by his intuition and other irrelevant factors like making instant profits, lack of awareness about market demand, overestimating a soil's potential to support a particular crop, and so on. A very misguided decision on the part of the farmer could place a significant strain on his family's financial condition. Perhaps this could be one of the many reasons contributing to the countless suicide cases of farmers that we hear from media on a daily basis. In a country like India, where agriculture and related sector contributes to approximately 20.4 per cent of its Gross Value Added (GVA) [2], such an

erroneous judgment would have negative implications on not just the farmer's family, but the entire economy of a region. For this reason, we have identified a farmer's dilemma about which crop to grow during a particular season, as a very grave one. The need of the hour is to design a system that could provide predictive insights to the Indian farmers, thereby helping them make an informed decision about which crop to grow. With this in mind, we propose a system, an intelligent system that would consider environmental parameters (temperature, rainfall, geographical location in terms of state) and soil characteristics (pH value, soil type and nutrients concentration) before recommending the most suitable crop to the user.

Agriculture, as we all know, is the foundation of the Indian economy. Agriculture is an important occupation in India. More than 60% of the country's land is used for agriculture, which feeds 1.3 billion people [1]. Agriculture is the cultivation of plants and animals. In India, agriculture gave rise to civilization. We need soil to cultivate crops. As a result, soil is a critical factor in agriculture. Soil health is essential for good food production. It provides the roots with essential nutrients, water, oxygen, and support. Soil is the foundation of the food system, as well as the location of all plants used in food production. In India, several soil varieties are available. They are alluvial soil (cotton, rice), black soil (sugarcane, sunflower), red soil (corn, ragi), laterite soil (pulses, tea, coffee), and so on. Many studies have been conducted to improve agricultural planning. The crop can be recommended using a machine learning technique. Machine learning is a subfield of artificial intelligence that describes a machine's

ability to mimic intelligent human behavior. Artificial intelligence systems are employed in the same way as humans do to automate complex tasks [2]. Machine learning begins with data, such as financial transactions, individuals, or photos.

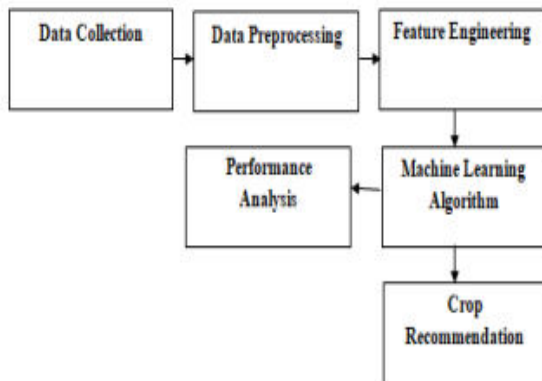


Fig.1: Example figure

India is one of the world's oldest countries with a thriving agricultural sector. However, due to globalisation, agricultural trends have radically changed in recent years. The state of agriculture in India has been influenced by a number of variables. Many innovative technologies have emerged to help people regain their health. Precision agriculture is one such technology. Crop suggestion is one of the most important aspects of precision agriculture. It is influenced by a number of factors. Not all precision agriculture systems are made equal. In agriculture, however, it is vital that the advice given is exact and precise, as mistakes can result in severe material and capital loss. Our country's farmers will profit as a result of this. Prior crop and yield predictions were made based on the farmers' previous experience in a given place. They will choose the preceding or neighbouring or trendier crop in the surrounding region purely for the sake of their land, and they have little awareness of soil nutrients like nitrogen, phosphate, and potassium. India's agriculture has advanced significantly in recent years. Precision agriculture relies on site-specific cultivation. Even while precision agriculture has progressed, it still has problems. Precision agriculture plays a significant part in crop recommendation. "The dataset contains various parameters like Nitrogen (N), Phosphorus (P), Potassium (K), PH value of soil, Humidity, Temperature, and Rainfall.

2. LITERATURE REVIEW

Crop Selection Method to Maximize Crop Yield Rate using Machine Learning Technique:

This paper proposed a method named Crop Selection Method (CSM) to solve crop selection problem, and maximize net yield rate of crop over season and subsequently achieves maximum economic growth of the country. The proposed method may improve net yield rate of crops.

AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms:

This paper, proposed and implemented an intelligent crop recommendation system, which can be easily used by farmers all over India. This system would assist the farmers in making an informed decision about which crop to grow depending on a variety of environmental and geographical factors. We have also implemented a secondary system, called Rainfall Predictor, which predicts the rainfall of the next 12 months.

Development of Yield Prediction System Based on Real-time Agricultural meteorological Information:

This paper contains about the research and the building of an elective agricultural yield forecasting system based on real-time monthly weather. It is difficult to predict the agricultural crop production because of the abnormal weather that happens every year and rapid regional climate change due to global warming. The development of agricultural yield forecasting system that leverages real-time weather information is urgently required. In this research, we cover how to process the number of weather data (monthly, daily) and how to configure the prediction system. We establish a non-parametric statistical model on the basis of 33 years of agricultural weather information. According to the implemented model, we predict production using the monthly weather information. This paper contains the results of the simulation.

Analysis of Soil Behaviour and Prediction of Crop Yield using Data Mining Approach:

This work presents a system, which uses data mining techniques in order to predict the category of the analyzed soil datasets. The category, thus predicted will indicate the yielding of crops. The problem of

predicting the crop yield is formalized as a classification rule, where Naive Bayes and K-Nearest Neighbor methods are used.

Crop Recommendation System for Precision Agriculture:

This paper, proposes a recommendation system through an ensemble model with majority voting technique using Random tree, CHAID, K-Nearest Neighbour and Naïve Bayes as learners to recommend a crop for the site specific parameters with high accuracy and efficiency.

3. METHODOLOGY

More and more researchers have begun to identify this problem in Indian agriculture and are increasingly dedicating their time and efforts to help alleviate the issue. Different works include the use of Regularized Greedy Forest to determine an appropriate crop sequence at a given time stamp. Another approach proposes a model that makes use of historical records of meteorological data as training set. Model is trained to identify weather conditions that are deterrent for the production of apples. It then efficiently predicts the yield of apples on the basis of monthly weather patterns. The use of several algorithms like Artificial Neural Network, K Nearest Neighbours, and Regularized Greedy Forest is demonstrated in to select a crop based on the prediction yield rate, which, in turn, is influenced by multiple parameters. Additional features included in the system are pesticide prediction and online trading based on agricultural commodities.

Disadvantages of Existing System:

One shortcoming that we identified in all these notable published works was that the authors of each paper concentrated on a single parameter (either weather or soil) for predicting the suitability of crop growth. However, in our opinion, both these factors should be taken together into consideration concomitantly for the best and most accurate prediction. This is because, a particular soil type may be π for supporting one type of crop, but if the weather conditions of the region are not suitable for that crop type, then the yield will suffer.

We to eliminate the aforementioned drawbacks, we propose a Crop Recommendation system which takes into consideration all the appropriate parameters, including temperature, rainfall, location and soil

condition, to predict crop suitability. This system is fundamentally concerned with performing the primary function of AgroConsultant, which is, providing crop recommendations to farmers algorithms. We also provide the profit analysis on crops grown in different states which gives the user an easy and reliable insight to decide and plan the crops.

Advantages of Proposed System:

- The proposed model predicts the crop yield for the data sets of the given region. Integrating agriculture and ML will contribute to more enhancements in the agriculture sector by increasing the yields and optimizing the resources involved. The data from previous years are the key elements in forecasting current performance.
- The proposed system uses recommender system to suggest the right time for using fertilizers.
- The methods in the proposed system includes increasing the yield of crops, real-time analysis of crops, selecting efficient parameters, making smarter decisions and getting better yield.

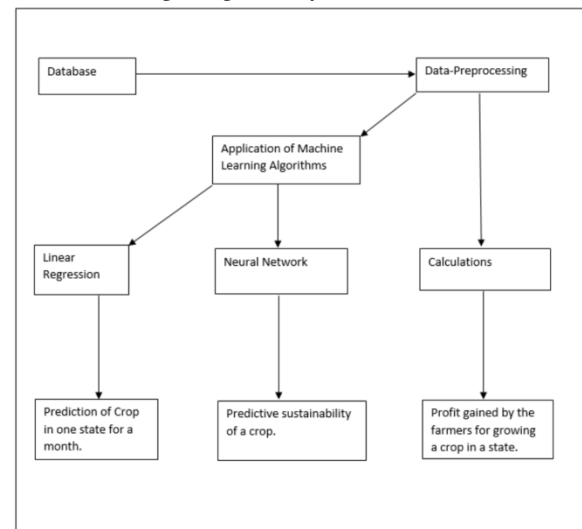


Fig.2: System architecture

MODULES:

In this project we have designed following modules

- Upload dataset
- Preprocessing
- Run algorithms
- Graph
- Predict crop

4. IMPLEMENTATION

Machine learning is an application of artificial intelligence (AI) that gives systems the ability to automatically learn and evolve from experience without being specially programmed by the programmer. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The main aim of machine learning is to allow computers to learn automatically and adjust their actions to improve the accuracy and usefulness of the program, without any human intervention or assistance. Traditional writing of programs for a computer can be defined as automating the procedures to be performed on input data in order to create output artifacts. Almost always, they are linear, procedural and logical.

Algorithms:

Neural Network:

Neural networks are a set of algorithms, modeled loosely after the human brain, that are designed to recognize patterns. They interpret sensory data through a kind of machine perception, labeling or clustering raw input. The patterns they recognize are numerical, contained in vectors, into which all real-world data, be it images, sound, text or time series, must be translated. Neural networks help us cluster and classify. Neural Networks are themselves general function approximations, which is why they can be applied to almost any machine learning problem about learning a complex mapping from the input to the output space.

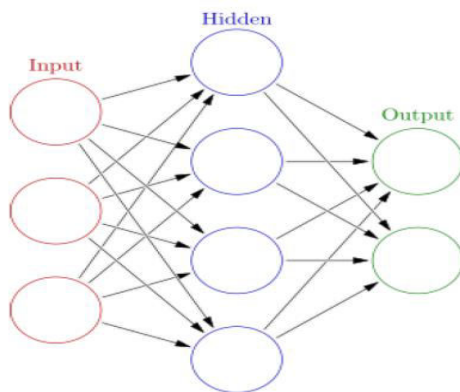


Fig.3: Neural network structure

Data Analysis:

One of the first steps we perform during implementation is an analysis of the data. This was done by us in an attempt to find the presence of any relationships between the various attributes present in the dataset.

Acquisition of Training Dataset:

The accuracy of any machine learning algorithm depends on the number of parameters and the correctness of the training dataset. We In this project analysed multiple datasets collected from Government website -<https://data.gov.in/> and Kaggle and carefully selected the parameters that would give the best results. Many works done in this field have considered environmental parameters to predict crop sustainability some have used yield as major factor where as in some works only economic factors are taken into consideration. We have tried to combine both environmental parameters like temperature, humidity, ph value, rainfall and p, n, k values and economic parameters like production, and yield to provide accurate and reliable recommendation to the farmer on which crop will be most suitable for his land.

temperat	humidity	ph	rainfall	N	P	K	label	label1
20.87974	82.00274	6.502985	202.9355	0.7	0.1	0.8	rice	1
21.77046	80.31964	7.038096	226.6555	0.5	0.7	0.4	rice	1
23.00446	82.32076	7.840207	263.9642	0.7	0.6	0.1	rice	1
26.4911	80.15836	6.980401	242.864	0.8	0.1	0.7	rice	1
20.13017	81.60487	7.628473	262.7173	0.5	0.8	0.2	rice	1
23.05805	83.37012	7.073454	251.055	0.8	0.4	0.6	rice	1
22.70884	82.63941	5.700806	271.3249	0.2	0.5	0.8	rice	1
20.27774	82.89409	5.718627	241.9742	0.6	0.6	0.7	rice	1
24.51588	83.53522	6.685346	230.4462	0.7	0.6	0.3	rice	1
23.22397	83.03323	6.336254	221.2092	0.6	0.7	0.6	rice	1
26.52724	81.41754	5.386168	264.6149	0.1	0.6	0.5	rice	1
23.97898	81.45062	7.502834	250.0832	0.2	0.8	0.7	rice	1
26.8008	80.88685	5.108682	284.4365	0.1	0.8	0.8	rice	1
24.01498	82.05687	6.984354	185.2773	0.7	0.5	0.5	rice	1
25.66585	80.66385	6.94802	209.587	0.7	0.2	0.8	rice	1
24.28209	80.30026	7.042299	231.0863	0.1	0.8	0.7	rice	1
21.58712	82.78837	6.249051	276.6552	0.2	0.5	0.6	rice	1
23.79392	80.41818	6.97086	206.2612	0.8	0.5	0.8	rice	1
21.86525	80.1923	5.953933	224.555	0.1	0.8	0.7	rice	1
23.57944	83.5876	5.853932	291.2987	0.5	0.6	0.4	rice	1
21.32504	80.47476	6.442475	185.4975	0.1	0.6	0.5	rice	1
25.15746	83.11713	5.070176	231.3843	0.1	0.7	0.6	rice	1

Fig.4: Training data

Data Pre-processing:

After analysing and visualizing the data, the next step is pre-processing. Data pre-processing is an important step as it helps in cleaning the data and making it suitable for use in machine learning algorithms. Most of the focus in pre-processing is to remove any outliers or erroneous data, as well as handling any missing values. Missing data can be dealt with in two ways. The first method is to simply remove the entire row which contains the missing or erroneous value.

While this an easy to execute method, it is better to use only on large datasets. Using this method on small datasets can reduce the dataset size too much, especially if there are a lot of missing values. This can severely affect the accuracy of the result. Since ours is a relatively small dataset, we will not be using this method. The dataset that we used had values that were in string format so we had to transform and encode the into integer valued so as to pass as an input to the neural network. First, we converted the data into pandas categorical data and then generated codes for crops and states respectively we than appended these and created separated datasets. The steps are illustrated below. Further to reduce the amount of data going into the linear regression model we filtered the crops based on the required nutrients and nutrients present in the soil. If the nutrient content of the soil was below that required by the crops, then that crop was discarded, in this way we were able to reduce the training time a lot.

5. EXPERIMENTAL RESULTS

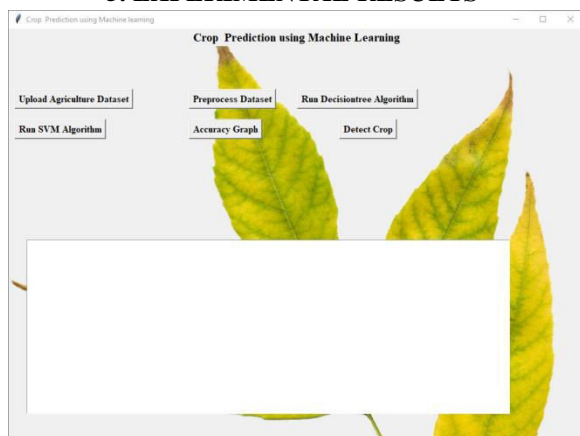


Fig.5: Home screen

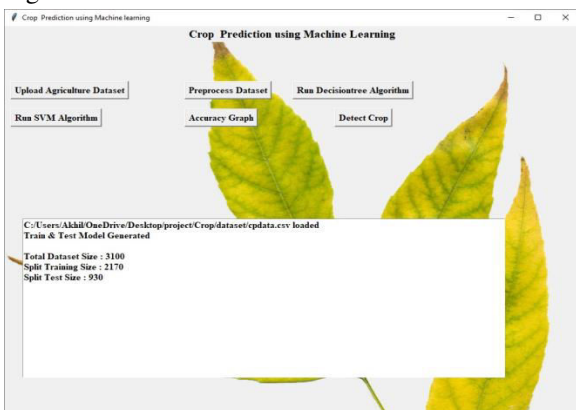


Fig.6: Dataset loading

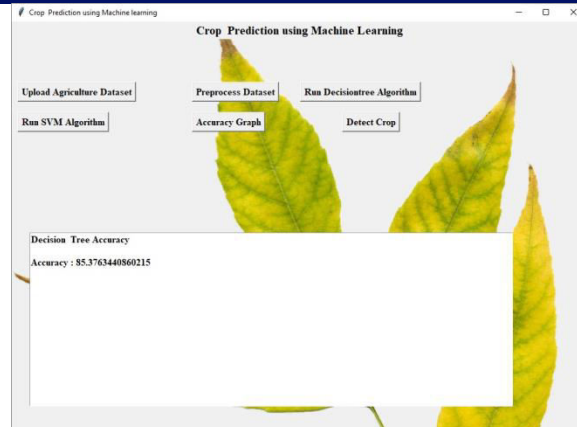


Fig.8: Decision tree

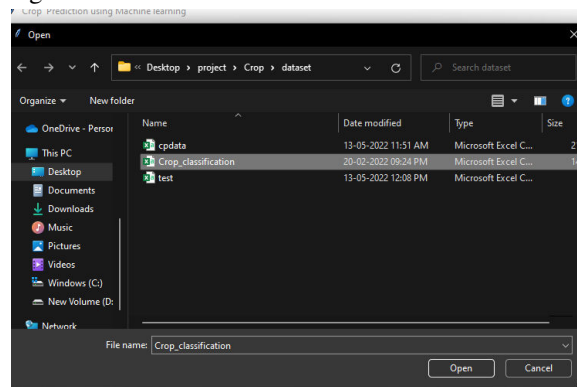


Fig.9: Test data loading

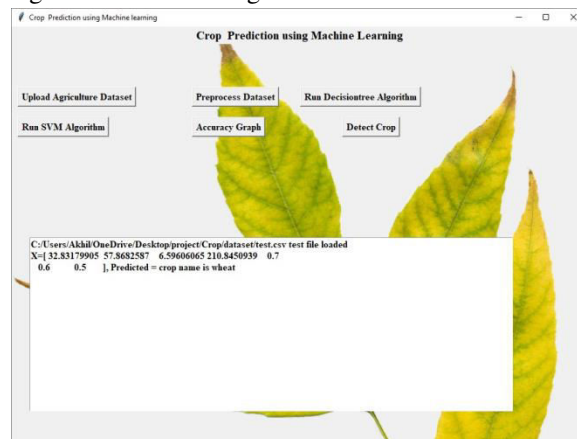


Fig.10: Prediction result

6. CONCLUSION

In a modern environment with less space and less knowledge of agriculture, all the factors are considered from the perspective of farmer and plant, and the farmer is properly guided until the harvesting. Before selecting any plant to grow it is important to have the knowledge and an understanding of the factors that affect the cultivation and how to maintain

or control them. From this system, these above-mentioned factors are automatically processed and select the crop type to be cultivated. Once the plant is cultivated, the farmer is asked for feedback regularly with a time interval of one month. From this feedback taken, the system self-trained, and the accuracy is improved with time and data collected. From this system, the guidance of a specialist is not needed, and the maintenance is less. Thus, implementing this system will not have any additional monetary impact on the user. This system helps the farmer to choose the right crop by providing insights that ordinary farmers don't keep track of thereby decreasing the chances of crop failure and increasing productivity. It also prevents them from incurring losses. The system can be extended to the web and can be accessed by millions of farmers across the country. We could achieve an accuracy of 86.13 percent from the Decision Tree Classifier.

7. FUTURE SCOPE

Further development is to integrate the crop recommendation system with another subsystem, yield predictor that would also provide the farmer an estimate of production if he plants the recommended crop.

REFERENCES

- [1] Niketa Gandhi et al, "Rice Crop Yield Forecasting of Tropical Wet and Dry Climatic Zone of India Using Data Mining Techniques", IEEE International Conference on Advances in Computer Applications (ICACA), 2016.
- [2] K.E. Eswari. L.Vinitha. "Crop Yield Prediction in Tamil Nadu Using Baysian Network ", International Journal of Intellectual Advancements and Research in Engineering Computations, Volume-6,Issue-2,ISSN: 2348-2079.
- [3] Shruti Mishra, Priyanka Paygude, Sinha Chaudhary, Sonali Idate "Use of Data Mining in Crop Yield Prediction" IEEE Xplore Compliant - Part Number:CFP18J06-ART, ISBN:978-1-5386-0807- 4; DVD PartNumber: CFP18J06DVD , ISBN:978-1-5386-0806-7.
- [4] Anna Chlingaryana, Salah Sukkarieha, Brett Whelanb — Machine learning approaches for crop yield prediction and nitrogen status estimation in precision agriculture: A review, Computers and Electronics in Agriculture 151 (2018) 61–69, Elsevier, 2018.
- [5] Dakshayini Pail et al, "Rice Crop Yield Prediction using Data Mining Techniques:An Overview", International Journal of Advanced Research in Computer Science and Software Engineering ,Volume 7, Issue 5, May 2017
- [6] AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms. Zeel Doshi , Subhash Nadkarni ,Rashi Agrawal, Prof. Neepa Shah.
- [7] Crop Recommendation System for Precision Agriculture S.Pudumalar*, E.Ramanujam*, R.Harine Rajashree, C.Kavya, T.Kiruthika, J.Nisha.
- [8] Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education. [9] Suresh, G., A. Senthil Kumar, S. Lekashri, and R. Manikandan. "Efficient Crop Yield Recommendation System Using Machine Learning For Digital Farming." International Journal of Modern Agriculture 10, no. 1 (2021): 906-914.
- [10] Reddy, D. Anantha, Bhagyashri Dadore, and Aarti Watekar. "Crop recommendation system to maximize crop yield in ramtek region using machine learning." International Journal of Scientific Research in Science and Technology 6, no. 1 (2019): 485-489.
- [11] Pudumalar, S., E. Ramanujam, R. Harine Rajashree, C. Kavya, T. Kiruthika, and J. Nisha. "Crop recommendation system for precision agriculture." In 2016 Eighth International Conference on Advanced Computing (ICoAC), pp. 32-36. IEEE, 2017.
- [12] Azizkhan F Pathan, Chetana Prakash, Attention-based position-aware framework for aspect-based opinion mining using bidirectional long short-term memory, Journal of King Saud University - Computer and Information Sciences, 2021,ISSN1319-1578.
- [13] Azizkhan F Pathan, Chetana Prakash, Unsupervised Aspect Extraction Algorithm for opinion mining using topic modeling, Global Transitions Proceedings, Volume 2, Issue 2, 2021, pp. 492-499, ISSN 2666-285X
- [14] Dighe, Deepti, Harshada Joshi, Aishwarya Katkar, Sneha Patil, and Shrikant Kokate. "Survey of Crop Recommendation Systems." (2018).

[15] Jaiswal, Sapna, Tejaswi Kharade, Nikita Kotambe, and Shilpa Shinde. "Collaborative Recommendation System For Agriculture Sector." In ITM Web of Conferences, vol. 32. EDP Sciences, 2020.



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