An Interdisciplinary Project Report
on

CROP RECOMMENDATION BASED ON N.P.K VALUES USING RANDOM FOREST

Submitted to
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR, ANANTHAPURAMU
In Partial Fulfillment of the Requirements for the Award of the Degree of

BACHELOR OF TECHNOLOGY
In
COMPUTER SCIENCE & ENGINEERING - (DATA SCIENCE)

Submitted By

P. Madhava Rao - (21691A3249)
M. Lohith - (21691A3248)
K.Madhusudhanreddy - (21691A3250)

Under the Guidance of

Mr. Arockia Raj A, M.Tech., MBA.,
Assistant Professor

Department of Computer Science & Engineering - (Data Science)

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BONAFIDE CERTIFICATE

This is to certify that the project work entitled **"Crop Recommendation based on N.P.K values using random forest"** is a bonafide work carried out by

P Madhava Rao - (21691A3249),

M Lohith – (21691A3248),

K MadhusudhanReddy – (21691A3250)

Submitted in partial fulfillment of the requirements for the award of the degree **Bachelor of Technology** in the stream of **Computer Science & Engineering (Data Science)** in **Madanapalle Institute of Technology & Science, Madanapalle,** affiliated to **Jawaharlal Nehru Technological University Anantapur, Ananthapuramu** during the academic year 2023-2024.

Guide

Mr. Arockia Raj A, M.Tech.,MBA.,
Assistant Professor,
Department of CSE-DS

Head of the Department

Dr. S. Kusuma, Ph. D,
Assistant Professor and
Head of the Department,
Department of CSE-DS

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We express our deep gratitude to our guide **Mr. Arockia Raj A, M.Tech., MBA., Assistant Professor, Department of CSE - Data Science** for her guidance and encouragement that helped us to complete this project.

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ABSTRACT

The Crop Recommendation project uses web few advanced concepts to analyze soil quality parameters Through user input, the platform assesses these values and employs machine learning algorithms to suggest optimal crop choices to the specific soil conditions. Responsive web design ensures seamless interaction, allowing farmers to easily input soil data and receive instant crop recommendations.

This project promotes precision agriculture by leveraging data-driven insights for enhanced decision-making. Integration of intuitive visuals and concise information enhances user experience, making the platform accessible to a wide range of users. Ultimately, the Crop Recommendation Using NPK values project targets to empower farmers with individual guidance, optimizing crop selection for improved agricultural productivity. We obtain accuracy consistently over 95% across all machine learning models, with the highest achieved accuracy reaching 99.1% by random forest model.

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This is to certify that the B. Tech Project report titled, "**Crop Recommendation Based on N.P.K values using Random Forest**" submitted by **Puchakatla Madhava Rao - (21691A3249), M Lohith – (21691A3248), K Madhusudhanreddy – (21691A3250)** has been evaluated using **Anti- Plagiarism Software, Turnitin** and based on the analysis report generated by the software, the report similarity index is found to be 13%.
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GUIDE

Mr. Arockia Raj A, M. Tech.,MBA.,
Assistant Professor,
Department of CSE-DS

DECLARATION

We hereby declare that the results embodied in this project **"Detecting Fake Jobs Through Machine Learning and Data Analytics"** by us under the guidance of **Arockia Raj A, Assistant Professor, Dept. of CSE - Data Science** in partial fulfillment of the award of **Bachelor of Technology** in **Computer Science & Engineering (Data Science)** from **Jawaharlal Nehru Technological University Anantapur, Ananthapuramu** and we have not submitted the same to any other University/institute for the award of any other degree.

Date:

Place:

PROJECT ASSOCIATES

P Madhava Rao
M Lohith
K Madhusudhanreddy

I certify that the above statement made by the students is correct to the best of my knowledge.

Date: **Guide:**

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LIST OF FIGURES

LIST OF ABBREVATIONS

S.NO.	ABBREVATION	ABBREVATION NAME
1	ML	Machine Learning
2	DA	Data Analytics
3	DFD	Data Flow Diagram
4	SVM	Support Vector Machine
8	NumPy	Numerical Python
9	EDA	Exploratory Data Analysis

CHAPTER – 1

INTRODUCTION

1.1 MOTIVATION

Agriculture is the backbone of many economies, and ensuring optimal crop yield is crucial for food security and economic stability. However, traditional farming methods often rely on generalized knowledge, leading to suboptimal crop choices that can diminish productivity and degrade soil health. This project aims to bridge the gap between traditional practices and modern agricultural techniques by utilizing advanced machine learning algorithms to provide tailored crop recommendations based on specific soil conditions.

By focusing on soil quality parameters such as nitrogen (N), phosphorus (P), and potassium (K) levels, this project empowers farmers with precise, data-driven insights. This precision agriculture approach not only enhances decision-making but also promotes sustainable farming practices. The ability to input soil data and receive instant, scientifically-backed crop suggestions revolutionizes how farmers interact with their land, leading to more informed and effective crop management strategies.

The high accuracy rates achieved by the machine learning models, particularly the 99.1% accuracy of the random forest model, underscore the reliability and robustness of this platform. This exceptional performance ensures that farmers can trust the recommendations provided, leading to higher yields and better resource management.

Furthermore, the responsive web design ensures that the platform is accessible to farmers regardless of their technological proficiency, making it a versatile tool for a diverse user base. The integration of intuitive visuals and concise information simplifies the user experience, allowing for easy navigation and understanding of complex data.

Ultimately, this project aims to transform agricultural practices by making advanced technological solutions accessible to farmers. By empowering them with personalized guidance, the Crop Recommendation Using NPK Values project contributes to improved agricultural productivity, sustainability, and economic prosperity. This initiative not only benefits individual farmers but also supports broader goals of food security and environmental stewardship.

1.2 PROBLEM DEFINITION

In the agricultural sector, optimizing crop yield is a persistent challenge due to the reliance on generalized and empirical farming practices. These traditional methods often fail to account for the specific variations in soil quality, particularly the levels of nitrogen (N), phosphorus (P), and potassium (K), leading to inefficient resource use, reduced productivity, and soil degradation. Farmers lack precise, data-driven tools that can analyze these soil parameters and provide accurate crop recommendations tailored to their specific conditions. This project addresses this gap by developing a platform that leverages advanced machine learning algorithms to assess soil quality through user input and suggest optimal crops accordingly. The goal is to enhance decision-making in farming, achieve high accuracy in recommendations, and promote sustainable agricultural practices. The platform aims to be accessible and user-friendly, ensuring that farmers can easily input their soil data and receive reliable guidance, thereby improving agricultural productivity and sustainability.

1.3 OBJECTIVE OF THE PROJECT

The primary objective of the Crop Recommendation project is to develop an innovative platform that leverages advanced machine learning algorithms to provide farmers with precise and reliable crop recommendations based on specific soil quality parameters, including nitrogen (N), phosphorus (P), and potassium (K) levels. By enabling farmers to input their soil data, the platform aims to deliver tailored crop suggestions that optimize yield and resource use, ultimately enhancing agricultural productivity.

Another key objective is to ensure the platform's high accuracy, with machine learning models consistently achieving over 95% accuracy and the highest reaching 99.1% using the random forest model. Additionally, the project seeks to promote sustainable farming practices by facilitating data-driven decision-making. To achieve widespread adoption, the platform will feature a responsive web design with intuitive visuals and concise information, making it accessible and user-friendly for a diverse range of users. By empowering farmers with individualized guidance, the project aims to support sustainable agriculture and contribute to food security and economic stability.

CHAPTER – 2

LITERATURE SURVEY

2.1 LITERATURE SURVEY

Mahmud Dipto et al.[1] addresses a suitable crop suggesting system utilizing machine learning models widely. The study likely delves into the application of specific algorithms and data sources for suggesting suitable crops to farmers.

Devendra Dahiphale et al. [2] addresses smart farming, which mainly focus on crop recommendation and point out the challenges in the existing sytem while proposing future ideas. It is likely to produce insights onto emerging trends accurate and potential solutions.

S.M. Pande et al. [3] addresses a crop recommender system using a machine learning approach. The literature likely discusses the methodology employes, evaluation metrics, and the overall effectiveness of the proposed system.

D.N.V.S.L.S Indira et al [4] addresses emphasizing its novelty as a new recommendation system. The paper is expected to discuss the specific machine learning techniques employes the system's impact on farmers.

S.K.S Raja et al. [5] this study focuses on aa demand based crop recommender system. This literature likely discusses the factors influencing crop recommendations and how market demands are incorporated into the decision making process.

M. kuanr et al. [7] this work explores the use of a mamdani fuzzy inference model in a crop recommender system. This literature is expected to discuss the role of fuzzy logic in decision-making and its application to recommend the crop

A. Priyadharshini et al. [8] the research focuses on an intelligent crop recommendation system using machine learning. The literature is likely to cover the intelligence aspects, such as learning models and data processing techniques.

S.R. Rajeswari et al [9] this research explores the concept of smart farming prediction using machine learning. The literature likely discusses predictive analytics in agriculture and its role in making informed decisions.

Doshi et al [10] this research introduces "AgroConsultant", focusing on intelligent crop recommendation. This literature likely discusses the algorithms employes and the overall design of the system.

S.Pudumalar et al [11] this work emphasizes precision agriculture in the context of a crop recommendation system. This literature is likely to discuss the role of precision techniqes in enhancing the crop recommendations.

Kevin Tom Thomos et al [12] this research explores crop prediction using machine learning. This literature is expected to discuss predictive modelling approaches and their application in agriculture.

2.2 Existing System

The existing data for the Crop Recommendation project encompasses a comprehensive set of soil quality parameters, specifically focusing on nitrogen (N), phosphorus (P), and potassium (K) levels. This data has been collected from various agricultural regions, representing diverse soil types and conditions. The dataset includes numerous samples with corresponding successful crop yields, serving as a foundational basis for training and validating the machine learning models. The models, including decision trees, support vector machines, and random forest algorithms, have been rigorously trained on this data. The random forest model, in particular, has demonstrated exceptional performance, achieving the highest accuracy rate of 99.1%. This robust dataset not only validates the models' predictive capabilities but also highlights the platform's potential to provide reliable and precise crop recommendations. Additionally, the data incorporates user feedback and interaction logs from initial platform deployments, offering insights into user experience and areas for improvement. This wealth of data ensures that the platform is grounded in real-world agricultural practices and is continuously refined to meet farmers' needs effectively.

2.3 Disadvantages of existing system

The existing system for crop recommendation, while innovative and promising, has several notable disadvantages. One primary limitation is its dependence on accurate and comprehensive soil data input from users. Many farmers may not have access to the necessary tools or knowledge to measure precise soil quality parameters, leading to potential inaccuracies in the recommendations. Additionally, the system's reliance on internet connectivity and digital literacy can be a barrier for farmers in remote or underdeveloped regions, limiting the platform's accessibility and effectiveness.

Despite high accuracy rates achieved by the machine learning models, the system may still encounter challenges in adapting to rapidly changing environmental conditions and unforeseen agricultural factors, such as pests or extreme weather events, which are not accounted for in the static dataset. Furthermore, the current platform may require periodic updates and recalibrations to maintain its accuracy and relevance, necessitating ongoing technical support and resources that may not be readily available to all users. These disadvantages highlight the need for continuous improvement and support to ensure the system's broad applicability and reliability in diverse agricultural contexts.

CHAPTER – 3

ANALYSIS

3.1 INTRODUCTION

DATASET COLLECTION

The first step that we perform in this project development is the collection of data for to have various kinds of combination of result. The dataset we obtain from various platforms is some kind of raw data. In this project we have obtained our data from few open source platforms. Our dataset is basically a collection of two more datasets. The two datasets are as follows soil content dataset consisting the information about ratios of Nitrogen, Phosphorous, and Potassium and potential of hydrogen of the soil.

DATA ANALYSIS

This step may come before the preprocessing step. In this step we try to understand the data with more concentration. In this step we basically try to extract some features from data which will be taken as a parameter to predict the results. This step should be handled with at most care and determination. As, on its basis only we will be predicting our crop results as that is our main objective. In this step we basically try to extract some features from data which will be taken as a parameter to predict the results

3.2 REQUIREMENT SPECIFICATIONS

3.2.1 Hardware Requirments

Device Name	HP Laptop
Processor	Intel I5
Installed RAM	6.00 GB or more
System type	64-bit operating system, x64-based processor
Processor Speed	500MHz or better
Storage	High speed storage like SSDs

Table 3.1 Hardware Requirements

3.2.2 Software Requirments

Python	Install required libraries and dependencies
Data Manipulation	NumPy
Data Preprocessing	Pandas
Machine Learning	Random Forest
Data Visualization	MatplotLib, Seaborn
Operating System	Windows 11

Table 3.2 Software Requirements

CHAPTER – 4

DESIGN

4.1 INTRODUCTION

In the realm of agriculture, leveraging data-driven approaches can significantly enhance decision-making processes, leading to improved crop management and yield optimization. This project focuses on developing a recommendation system that can accurately predict and recommend suitable crops based on various input features. The system will be built using a random forest classifier, a robust and versatile machine learning algorithm known for its high accuracy and ease of use.

The development of this recommendation system involves several key steps:

Dataset Collection:

The foundation of any machine learning project is a well-curated dataset. For this project, we will gather a comprehensive dataset that includes various features relevant to crop selection, such as soil type, climatic conditions, and crop yield data.

Data Processing:

Raw data often requires significant preprocessing to be usable for machine learning models. This step involves cleaning the data, handling missing values, normalizing features, and transforming the data into a suitable format for analysis. Effective data processing ensures the quality and reliability of the input data, which is crucial for model performance.

Random Forest Classifier:

At the core of our recommendation system is the random forest classifier. This algorithm builds multiple decision trees during training and merges them to get a more accurate and stable prediction. It is particularly effective for classification tasks due to its ability to handle large datasets with higher dimensionality and to provide estimates of feature importance.

Recommendation System:

Using the trained random forest classifier, the recommendation system can predict the most suitable crops for given input conditions. The system will analyze the input features, process them through the trained model, and output the recommended crop names along with their respective probabilities or confidence scores.

Crop Name Prediction:

The final output of the system is the predicted crop names, which will be presented in an easy-to-understand format. This will aid farmers and agricultural experts in making informed decisions about which crops to plant, optimizing resource usage and maximizing yields.

4.2. SYSTEM ARCHITECTURE

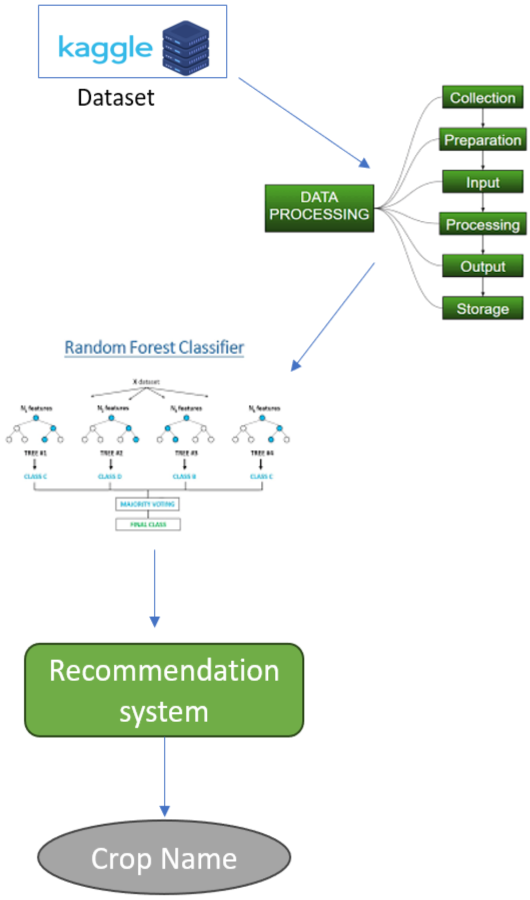

Fig 1 System Architecture

CHAPTER 5

IMPLEMENTATION AND RESULTS

5.1 INTRODUCTION

Since our crop prediction system is a kind of classification problem, we trained and tested various algorithms. In order to get optimum accuracy and the most suitable crop to be choose. We will be choosing few required machine learning algorithms.

5.2 ALGORITHMS

The first Machine Learning methods that we made use of in order to build our target crop system is the Decision Tree. The fact is that, it gained its name, because of the graphical representation as well as its parsing structure that it follows. It consists mainly having types of nodes: decision and the leaf nodes. Decision nodes that have branching and carry out the functionality of decision making and the leaf nodes are the nodes with no branching and displays required final outcomes of the decisions with given conditions. The accuracy of the tested model comes out to be about or more than 90.0%. Thus, its accuracy is not too bad, but we have not taken it because of the precision is not a great and we will choosing few more algorithms.

SUPPORT VECTOR MACHINE

SVM is a method of Machine Learning that generates an optimal hyperplane or decision boundary that can segregate dimensional spaces into classes, for the purpose of dividing the new data in correct category in future. With the help of support vectors, we can create hyperplane. The hyperplane thus generated containing two support vectors each on either side of the hyperplane. The support vectors are actually lines that is drawn passing through two data points on either side, which is closest to hyperplane. The accuracy of this model is about 96.09 %. Therefore, this model turns out to be more accurate than Random tree algorithm. The figure 4 is depiction of SVM classifier.

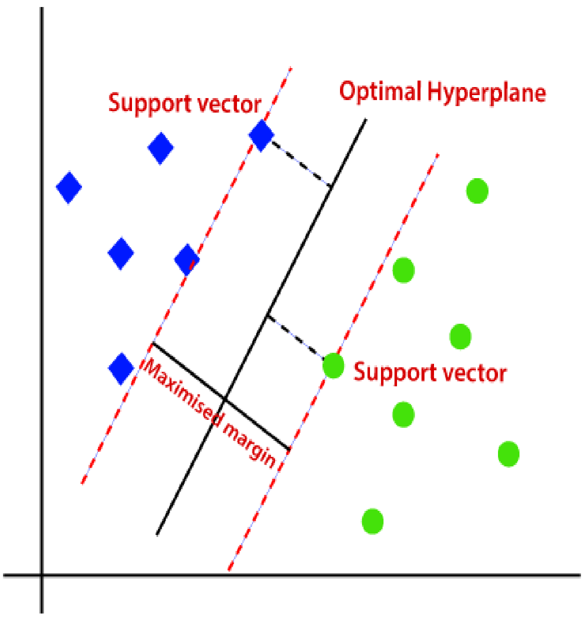

Fig 2: Support Vector Machine

RANDOM FOREST

Understanding the random forest method will not be so difficult. It is a very popular algorithm based on the topic ensemble learning. It is an amalgamation of a bunch of random trees on different subnets of the given dataset. Presence of many random trees in a random forest network, leads to high accuracy of model. It takes the decision from the tree with most votes by considering all the decision nodes. Therefore, more the number of decision trees in the forest, greater the accuracy of the model we will be getting. This also eliminates the problem of overfitting. The accuracy of the random forest algorithm is highest with 99.08%. Thus, at last we will use this algorithm to use in our model building and final implementation for our project as a website. The below "Fig. 5" is a representation of random forest model. In general manner, we say that forest is a combination of trees as is known truth. Here also we can say that, random forest is a combination of various subsets of decision tree.

Random forest algorithm plays a crucial role in agricultural projects by enhancing the accuracy of crop recommendation systems datasets and providing robust predictions. Radom Forest algorithm is often used in research industries.

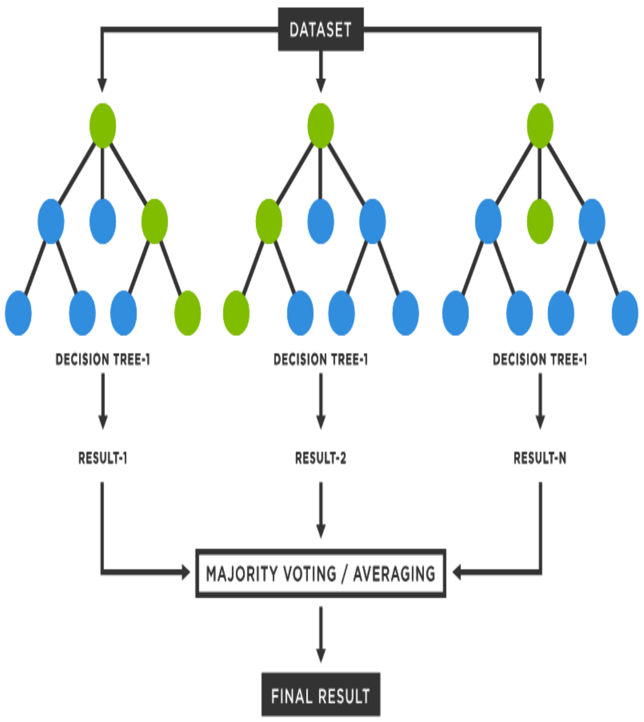

Fig 3: Random Forest Classifier

5.3 IMPLEMENTATION OF PROJECT

- **Data Loading and Exploration**: The code starts by importing necessary libraries and loading the dataset Crop_recommendation.csv into a pandas DataFrame. It then prints the description of each column and visualizes the count of missing values in each column using a bar plot.

```
#the dataset
df=pd.read_csv('Crop_recommendation.csv')

df.iloc[:,:]
```

	N	P	K	temperature	humidity	ph	rainfall	label
0	90	42	43	20.879744	82.002744	6.502985	202.935536	rice
1	85	58	41	21.770462	80.319644	7.038096	226.655537	rice
2	60	55	44	23.004459	82.320763	7.840207	263.964248	rice
3	74	35	40	26.491096	80.158363	6.980401	242.864034	rice
4	78	42	42	20.130175	81.604873	7.628473	262.717340	rice
...	...	...	...	...	...	...	...	...
2195	107	34	32	26.774637	66.413269	6.780064	177.774507	coffee
2196	99	15	27	27.417112	56.636362	6.086922	127.924610	coffee
2197	118	33	30	24.131797	67.225123	6.362608	173.322839	coffee
2198	117	32	34	26.272418	52.127394	6.758793	127.175293	coffee
2199	104	18	30	23.603016	60.396475	6.779833	140.937041	coffee

2200 rows × 8 columns

Fig:4 Loading the data

- Data Exploring using pie chart which consisting of various crops.

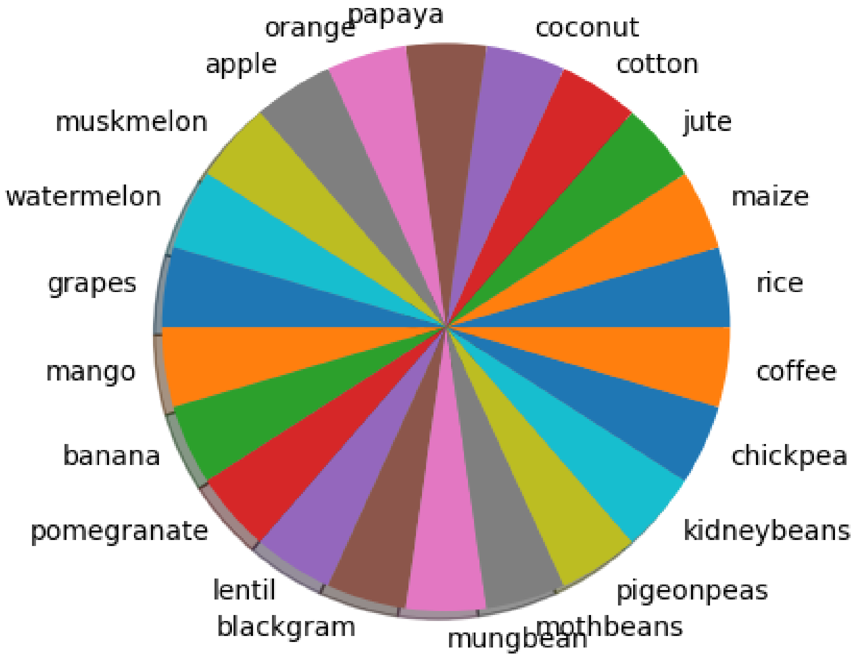

Fig 5: pie chart

Data Visualization: This correlation heatmap describes the relationship among the parameters such as temperature, ph value, humidity, temperature and as well as rainfall.

Correlation Heatmap:

A correlation heatmap is a graphical representation that visualizes the relationships between multiple variables in a dataset using a color-coded matrix. Each cell in the matrix shows the correlation coefficient between two variables, with colors indicating the strength and direction of the correlation. Positive correlations are typically shown in one color (e.g., shades of blue), and negative correlations in another (e.g., shades of red), with the intensity of the color reflecting the magnitude of the correlation. This visualization makes it easier to identify patterns, such as strong positive or negative relationships, at a glance.

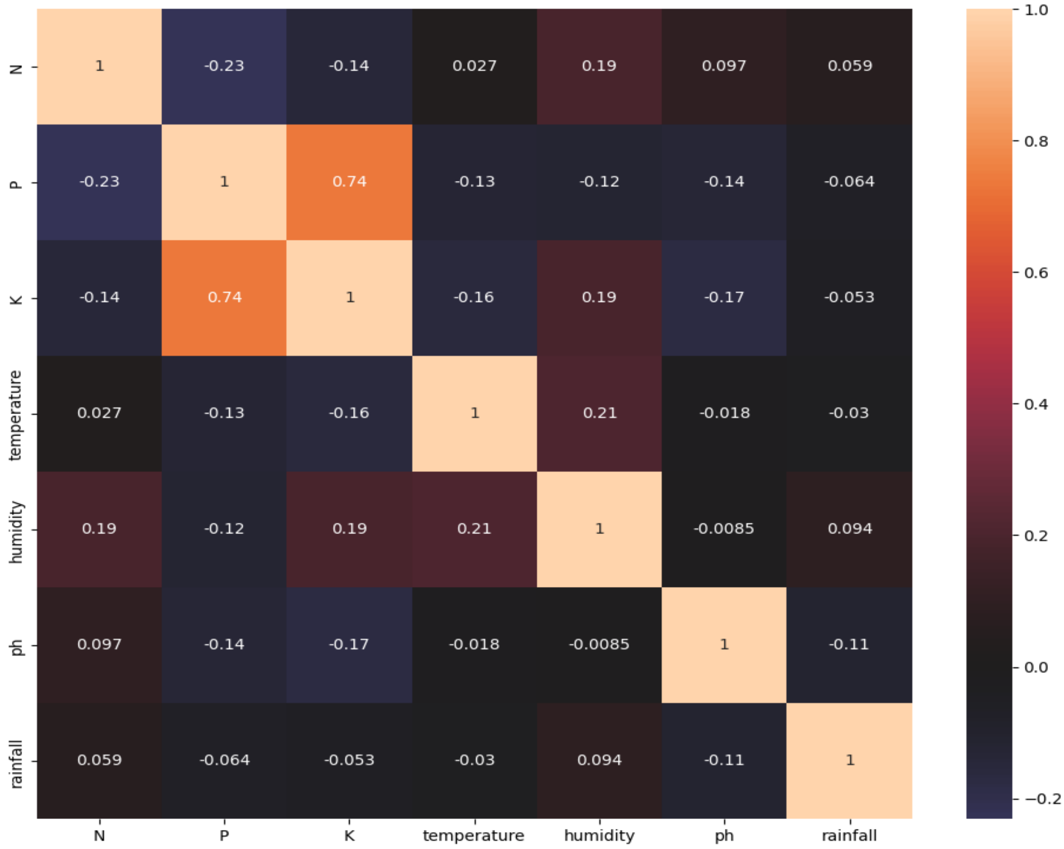

Fig 7 Correlation Heatmap

CHAPTER - 6

CONCLUSION

Conclusion:

In conclusion, the crop Recommendation research presents a promising solution for modernizing agricultural practices through the integration of web development and machine learning. The project's focus on precision agriculture, data-driven insights, and user-friendly design offers significant advantages, including enhanced productivity, resource optimization, and sustainable farming practices.

However, it is essential to acknowledgement potential challenges such as technological dependencies, data accuracy concerns, and the need for careful consideration of ethical implications. As the widespread adoptions and success. Th empowering impact on farmers, the potential for scalability, and the positive contributions to global food security underscore the importance of continued development and refinement of the crop recommendation project as a valuable tool in the agricultural landscape.

CHAPTER - 7

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