Crop Recommendation System Using KNN

A Major Project Report Submitted to

Rajiv Gandhi Proudyogiki Vishwavidyalaya

Towards Partial Fulfillment for the Award of

Bachelor of Engineering in Computer Science Engineering

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EXAMINER APPROVAL

The Major Project entitled **"Crop Recommendation System with KNN"** submitted by **Abhishek Sharma (0827CS201012), Alokit Sharma(0827CS201023), Ankita Arya (0827CS201034), Asit Joshi (0827CS201045)** has been examined and is hereby approved towards partial fulfillment for the award of Bachelor of Technology degree in Computer Science Engineering discipline, for which it has been submitted. It understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed, or conclusion drawn therein, but approve the project only for the purpose for which it has been submitted.

(Internal Examiner) **(External Examiner)**

Date: **Date:**

RECOMMENDATION

This is to certify that the work embodied in this major project entitled **"Crop Recommendation System with KNN"** submitted by **Abhishek Sharma (0827CS201012), Alokit Sharma(0827CS201023), Ankita Arya (0827CS201034), Asit Joshi (0827CS201045),** is a satisfactory account of the bonafide work done under the supervision of **Prof. Juhi Shrivastava**, is recommended towards partial fulfillment for the award of the Bachelor of Technology (Computer Science Engineering) degree by Rajiv Gandhi Proudyogiki Vishwavidhyalaya, Bhopal.

(Project Guide)

(Project Coordinator)

(Dean Academics)

STUDENTS UNDERTAKING

This is to certify that the major project entitled **"Crop Recommendation System with KNN"** has been developed by us under the supervision of **Prof. Juhi Shrivastava**. The whole responsibility of the work done in this project is ours. The sole intention of this work is only for practical learning and research.

We further declare that to the best of our knowledge; this report does not contain any part of any work which has been submitted for the award of any degree either in this University or in any other University / Deemed University without proper citation and if the same work is found then we are liable for explanation to this.

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We owe a debt of sincere gratitude, deep sense of reverence and respect to our guide and mentor **Prof. Juhi Shrivastava,** Assistant Professor, AITR, Indore for her motivation, sagacious guidance, constant encouragement, vigilant supervision, and valuable critical appreciation throughout this project work, which helped us to successfully complete the project on time.

We express profound gratitude and heartfelt thanks to **Dr. Kamal Kumar Sethi**, Professor & Head CSE, AITR Indore for his support, suggestion, and inspiration for carrying out this project. We are very much thankful to other faculty and staff members of the department for providing us all support, help and advice during the project. We would be failing in our duty if we do not acknowledge the support and guidance received from **Dr. S.C. Sharma**, Director, AITR, Indore whenever needed. We take the opportunity to convey my regards to the management of Acropolis Institute, Indore for extending academic and administrative support and providing me all necessary facilities for the project to achieve our objectives.

We are grateful to our parents and family members who have always loved and supported us unconditionally. To all of them, we want to say “Thank you”, for being the best family that one could ever have and without whom none of this would have been possible.

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EXECUTIVE SUMMARY

Crop Recommendation System with KNN

This project is submitted to Rajiv Gandhi Proudyogiki Vishwavidhyalaya, Bhopal (MP), India for partial fulfillment of Bachelor of Engineering in Information Technology branch under the sagacious guidance and vigilant supervision of Prof. Juhi Shrivastava.

Our project is a web application designed to help farmers maximize crop yields and simplify crop selection. By collecting data on factors like rainfall, temperature, and soil type, our machine learning model predicts crop yields. We use an ensemble of classifiers for accuracy and a ranking technique for efficient decision-making. This system empowers farmers with valuable insights, ultimately improving agricultural productivity.

Keywords: KNN,SVM.

“Where the vision is one year, cultivate flowers; Where the vision is ten years, cultivate trees; Where the vision is eternity, cultivate people.”

- Oriental Saying

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List of Abbreviations

Abbr1: KNN – K-Nearest Neighbor

Abbr2: SVM – Support Vector Machine

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Chapter 1

Introduction

Foreign nations have started using and implementing modern methods for the purpose of their profit. They already have gained such an upper hand in applying scientific and technological methods in the field of agriculture and farming to increase its quality of work that one can only imagine. Whereas, India still is holding on to the traditional approach towards farming and its technologies. As, we know, that singularly agriculture alone generates a huge percentage of revenue for our country. The income come is pretty handy, when we talk about the Gross Domestic Product value. Moving forward towards globalization, the need for food has grown exponentially. Farmer tries to increase the quantity of their production by adding different artificial fertilizers, which eventually results in a future environmental harm. But if the farmer knows exactly which crop to be sown according to different soil contents and environment conditions, then this will minimize the loss and results in efficient crop production . We have gathered a dataset, which consist of information about rainfall, climatic conditions and different soil nutrients. This will provide us better understanding of trends of crop production in consideration of geographical and environment factors. Our system also predicts the shortage of any particular components for growing a specific crop. Our predictive system can prove to be a great boon for agricultural industry. The trouble of nutrient insufficiency in areas, which occurred due to the reason of planting incorrect crop at wrong period of time, is abolished with the help of our predictive system. This results in scaling down the production efficiency of farmers. More and more scientific approach towards agriculture industry, will definitely take it to greater heights. We propose this system to provide farmers, knowledge about requirements of different minerals and climatic conditions, which are suitable for producing certain crops. Also, our project diverts our focus towards the lack of different minerals required to grow some crops, and proposes

us the remedies to eliminate their shortage. Our system considers factors such as soil composition and climatic factors like temperature, rainfall and humidity.

1.1 Overview

In India agriculture holds an incredibly predominant position in the expansion of our country's financial system. It is one of the fields which generates most of the employment opportunity in our country. Farmers, due to lack of their knowledge about different soil contents and environment conditions, do not opt the exact crop for nurturing, which results into a major hinder in crop production. To eliminate this barrier, we have provided a system which offers a scientific approach to assist farmers in predicting the ample crops to be cultivated based on different parameters which affects the overall production. It also suggests them about several deficiencies of nutrients in the soil to produce a specific crop. It is in context of a website. We used the crop dataset which include parameters like temperature, rainfall, pH, and humidity for specific crops and applied different ML techniques to recommend crops with high accuracy and efficiency. Hence, it can be supportive for farmers to be furthermore extra versatile.

1.2 Background and Motivation

Scenario is changing with the advent of Machine Learning initiatives at government as well as at private or individual level. Unlike traditional commerce that is carried out physically with effort of a person to go & get reports , Machine Learning has made it easier for humans to reduce physical work and to save time.

Motivation behind this farmers can get the information of which crop has to be grown according to their soil.

1.3 Problem Statement and Objectives

Data set collection from various sources. Data parsing and cleansing technique is applied to make the raw data into processing data. The data collected is subject to machine learning system along with run time analysis makes an efficient crop value

updation system. Usage of Ensemble of classifiers makes the model more robust and efficient. Ranking technique used in the project helps us to make efficient decisions. Creating a web application for user registrations and collection of data. The main objective is to obtain a better variety of crops that can be grown over the season. The proposed system would help to minimize the difficulties faced by farmers in choosing a crop and maximize the yield. The model predicts the crop yield by studying factors such as rainfall, temperature, area, season, soil type etc.

1.4 Scope of the Project

This Project can be used to get the student performance with more accuracy than any other model published earlier and we can also make some mobile or web application based on the model. Through this project we are making a revolution in Agriculture field . Farmers can obtain a better variety of crops that can be grown
over the season. The proposed system would help to minimize the difficulties faced by farmers in choosing a crop and maximize the yield. The model predicts the crop yield by studying factors such as rainfall, temperature, area, season, soil type etc.

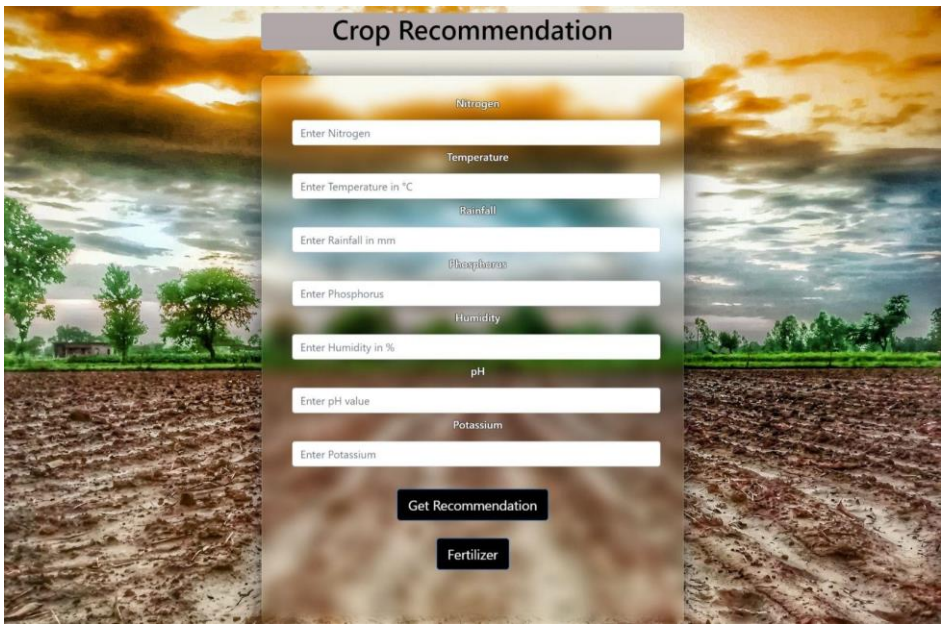

Figure 1-1. User Interface

1.5 Team organization

Abhishek Sharma: I was responsible for the work in the frontend and used JavaScript to add functionality to the website.

Alokit Sharma: I was responsible for the documentation and frontend of the project.

Ankita Arya: I created a Use Case and ER Diagram and worked on the backend of the project.

Asit Joshi: I was responsible for the backend of the project for model generation.

1.6 Report Structure

The project 'Ecommerce for Artisans' is primarily concerned with the underprivileged rural artisans and to promote the traditional Indian Art work. The entire project report is categorized into five chapters.

Chapter 1: Introduction - introduces the background of the problem followed by rationale for the project undertaken. The chapter describes the objectives, scope and applications of the project. Further, the chapter gives the details of team members and their contribution in development of the project which is then subsequently ended with a report outline.

Chapter 2: Review of Literature - explores the work done in the area of Project undertaken and discusses the limitations of the existing system and highlights the issues and challenges of the project area. The chapter finally ends up with the requirement identification for present project work based on findings drawn from reviewed literature and end user interactions.

Chapter 3: Crop Recommendation System with KNN - starts with the project proposal based on requirement identified, followed by benefits of the project. The chapter also illustrates the software engineering paradigm used along with different design representations. The chapter also includes a block diagram and details of major modules of the project. Chapter also gives insights of different types of feasibility study carried out for the project undertaken. Later it gives details of the different deployment

requirements for the developed project.

Chapter 4: Implementation - includes the details of different Technology/ Techniques/ Tools/ Programming Languages used in developing the Project. The chapter also includes the different user interfaces designed in the project along with their functionality. Further it discusses the experiment results along with testing of the project. The chapter ends with evaluation of the project on different parameters.

Chapter 5: Conclusion - Concludes with objective wise analysis of results and limitation of present work which is then followed by suggestions and recommendations for further improvement.

Chapter 2
Review of Literature

The India is a nation with a rich cultural legacy, and the country's diverse cultures produce a wide variety of exquisite soils and crops. Instead of using cutting-edge technology, the handicraft sector uses traditional manual processes to create a variety of goods. With the introduction of E commerce efforts at the government level as well as at the private or individual level, this situation is changing. Ecommerce has made it simpler for people to eliminate physical work and to save time, in contrast to conventional commerce, which is carried out physically with a person's effort to travel and collect items. The goal of this project is to emphasize the contribution of e-commerce to the growth of rural artisans in India by showcasing some of the initiatives taken by government and non-government organizations, groups, and individuals to improve their socioeconomic standing.

2.1 Preliminary Investigation

2.1.1 Current System

There aren’t many systems that are dedicated to Crop Detection. Some features of existing systems are:

The computational and data demands of structural price forecasting generally far exceed than what is routinely available in developing countries. Consequently, researchers often rely on parsimonious representations of price processes for their forecasting needs. Contemporary parsimonious form of price forecasting relies heavily on time series modelling. In time series modelling, past observations of the same variable are collected and analyzed to develop a model describing the underlying relationship. During the past few decades, much effort has been devoted to the development and improvement of time series forecasting models. Time series modelling requires less onerous data input for regular and up-to date price forecasting. Hence there is a need for better classification which would be an ensemble or hybrid classification model.

2.2 Limitations of Current System

- Efficiency is low.
- The existing system which recommends crop yield is either hardware-based being costly to maintain, or not easily accessible.
- Despite many solutions that have been recently proposed, there are still open challenges in creating a user-friendly application with respect to crop recommendation.
- More number of repeated work.

2.3 Requirement Identification and Analysis for Project

Significant work has been done in the field of Machine Learning ; however, it is not easy to achieve desired results. The review of literature leads to draw certain major findings which are as under:

- The study brought out that web development will be done and the research of frameworks, databases is done The project was developed by using Html, Sass, And Machine Learning Algorithms . The main aim of developing this project was to help the local artisans grow their businesses more and bring our traditional culture to light. Through our e-commerce website people can browse and view the local handicrafts made by our very own Indian Artisans and buy them at reasonable costs. We hope our project will provide a platform to all the local artists to display and sell their fine craftsmanship.

We think in today's world and in this economy it's very important to support the local craftsmen and admire their fine art and so this e-commerce website will not only help them but also help people buy their fine art sitting at home and ordering at their ease instead of going to shop for them specially.

- Study on Crops and soil is done and study about the how to training the model. Using Machine Learning Algorithms.
- Data analysis technology is used to update the crop yield rate change. The

concept of this paper is to implement the crop selection method so that this method helps in solving many agriculture and farmers problems. This improves our Indian economy by maximizing the yield rate of crop production. Different types of land condition. So the quality of the crops are identified using ranking process. By this process the rate of the low quality and high quality crop is also intimated. The usage of ensemble of classifiers paves a path way to make a better decision on predictions due to the usage of multiple classifiers. Further, a ranking process is applied for decision making in order to select the classifiers results. This system is used to predict the cost of the fertilizers for further. This project uses Ensemble of classifiers such as Decision tree and Random forest classifier. In addition, this project uses Ranking technique.

2.4 Conclusion

This chapter reviews the literature surveys that have been done during the research work. The related work that has been proposed by many researchers has been discussed. After surveying the existing systems, finding out the advantages and disadvantages . We have decided to make Machine Learning Model which will include all the art categories and art lovers can buy them also they can purchase raw material for it.

Chapter 3
Crop Recommendation System with KNN

3.1 The Proposal

The data analysis technology is used to update the crop yield rate change. The concept of this paper is to implement the crop selection method so that this method helps in solving many agriculture and farmers problems. This improves our Indian economy by maximizing the yield rate of crop production. Different types of land condition. So the quality of the crops are identified using ranking process. By this process the rate of the low quality and high quality crop is also intimated. The usage of ensemble of classifiers paves a path way to make a better decision on predictions due to the usage of multiple classifiers. Further, a ranking process is applied for decision making in order to select the classifiers results. This system is used to predict the cost of the fertilizers for further. This project uses Ensemble of classifiers such as Decision tree and Random forest classifier. In addition, this project uses Ranking technique.

3.2 Benefits of the Proposed System

The current project had a lot of challenges that are overcome by this system :

- Easy to Use : The user interface is so basic that it is very easy to understand and operate.
- All Crop Categories: Farmers can find all the categories of categories of crops according to their soil type and factors.
- Availability of Fertilizers : System will also show the suitable fertilizers for that crop .

3.3 Block Diagram of Crop Recommendation System with KNN

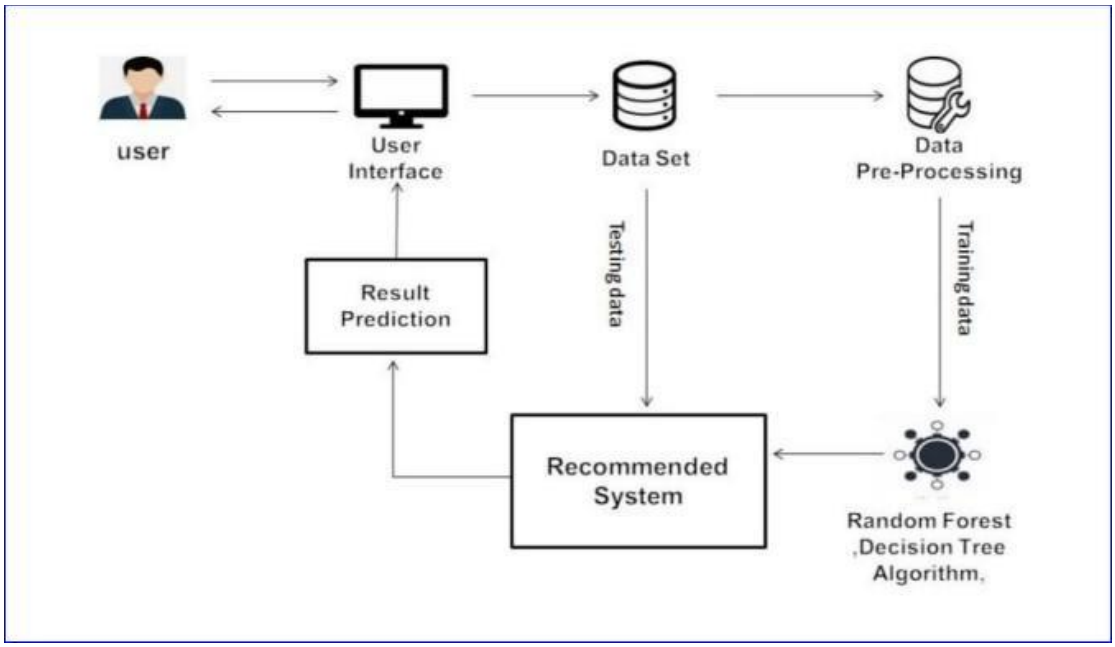

Figure 3-1 : Block Diagram of Crop Recommendation System with KNN

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3.4 Feasibility Study

A feasibility study is essential to assess the viability of implementing a project, considering various factors that can influence its success or failure. In the context of the Crop Recommendation System with KNN, we need to evaluate its technical, economic, and operational feasibility to ensure its effectiveness and sustainability.

3.4.1 Technical

The Crop Recommendation System with KNN relies on processing complex agricultural data and implementing machine learning algorithms for accurate predictions. For this purpose, we will leverage Python-based frameworks such as TensorFlow or scikit-learn for machine learning model development. These frameworks offer robust tools for data analysis and model training, ensuring technical feasibility.

Additionally, the system will require a web-based interface for user interaction. Using web development technologies like Django or Flask, we can create a user-friendly interface that provides farmers with easy access to crop recommendations based on their geographical and environmental conditions.

Furthermore, the system will need to handle large datasets efficiently to provide real-time recommendations. Implementing proper database management techniques and optimizing data retrieval processes will be crucial to ensure smooth operation even with extensive datasets.

Overall, considering the availability of suitable programming languages, frameworks, and technologies, the technical feasibility of the Crop Recommendation System with KNN is high.

3.4.2 Economical

The economic feasibility of the Crop Recommendation System with KNN involves evaluating the costs associated with its development, deployment, and maintenance against the potential benefits it offers to farmers and agricultural stakeholders.

Development costs will primarily include expenses related to software development, database setup, and integration of machine learning algorithms. Additionally, there will be costs associated with hosting the system on servers and ensuring its scalability to handle increasing user demands.

However, the potential benefits of the system, such as increased crop yields, optimized resource utilization, and reduced environmental impact, can outweigh the initial investment costs. By enabling farmers to make informed decisions about crop selection and nutrient management, the system can contribute to improved agricultural productivity and profitability.

Furthermore, the scalability of the system allows for future enhancements and updates, ensuring its long-term economic viability.

3.4.3 Operational

The main motto of our system is to reduce the manual efforts of creating music by automating it. The system can do that accurately and efficiently making the system operationally feasible.

3.5 Design Representation

3.5.1 Data Flow Diagrams

1 The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system,various processing carried out on this data, and the output data is generated by this system.

2 The data flow diagram (DFD) is one of the most important modeling tools. Itis used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.

3 DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.

4 DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.

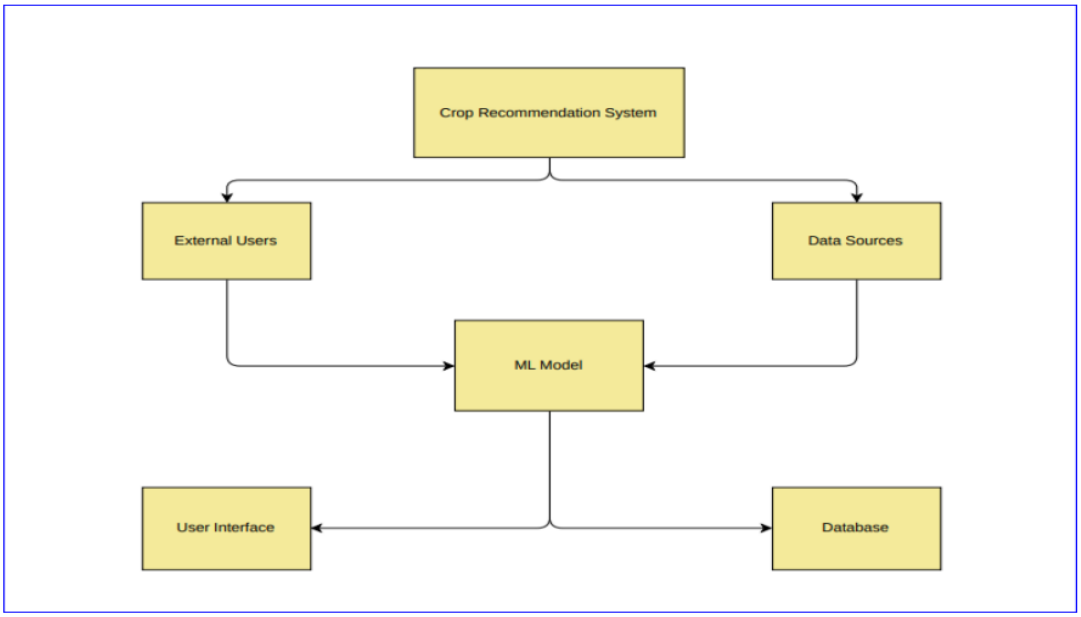

Figure 3-2: Data Flow Diagram Level 0

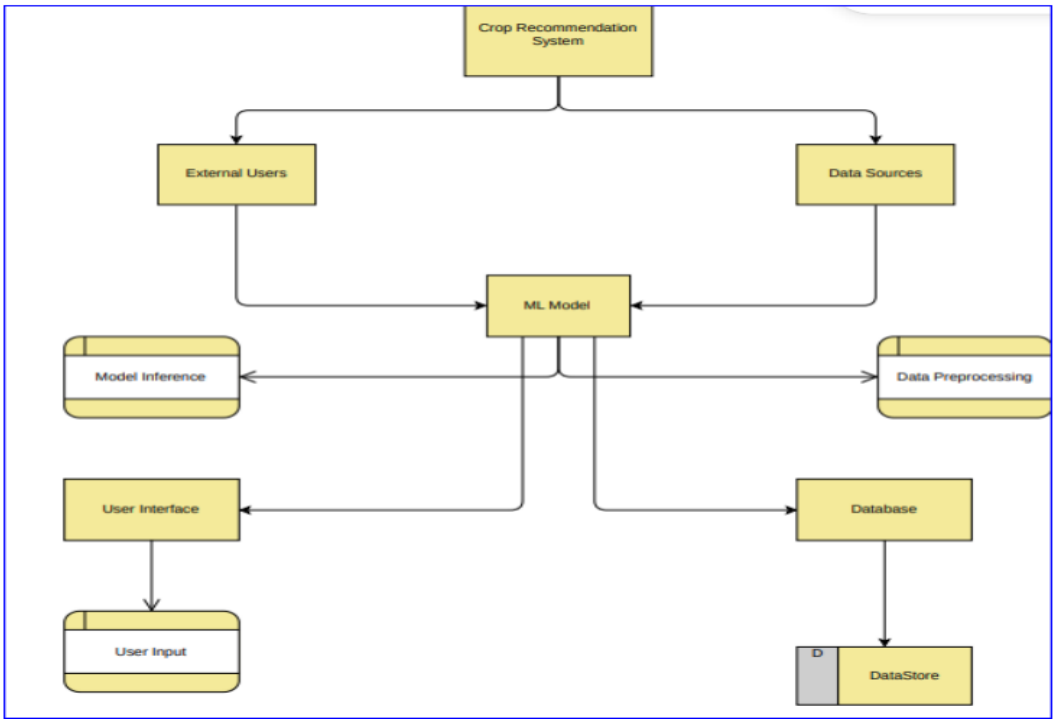

Figure 3-3: Data Flow Diagram Level

3.5.2 Use case diagram

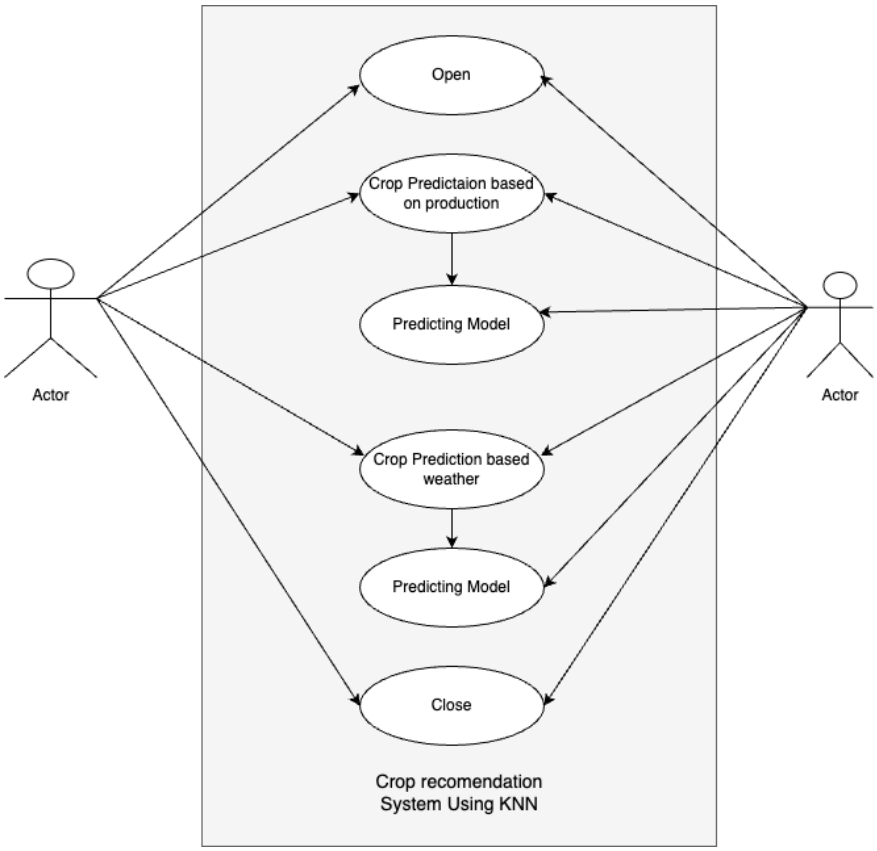

Figure 3-4: Use-case diagram of Crop Recommendation System with KNN

Figure 3-4 Explanation

Actors:

- **User**: Farmers or individuals seeking crop recommendations based on various factors such as production and product.
- **Admin**: Farmers Responsible for managing the system, including updating the prediction model and closing recommendations.

Use Cases:

- **Open:** Both the admin and user can access the system to initiate the recommendation process.
- **Crop Recommendation Based on Production:** User inputs production-related parameters such as soil type, climate conditions, and historical crop

yield.

- **Predicting Model:** Admin accesses the system to update or modify the prediction model used for crop recommendations.
- **Crop Prediction Based on Product:** User provides information about the desired crop output or product specifications.
- **Close:** Both admin and user can close the recommendation process once satisfied with the suggested crops or after making necessary adjustments.

Relationships:

- The user interacts with the system by inputting relevant production or product-related parameters.
- The system processes the user's inputs using the prediction model to generate crop recommendations.
- Admin oversees the system's functionality, including updating the prediction model and managing recommendations.

Overall, the use case diagram illustrates how users, both admin and farmers, interact with the Crop Recommendation System with KNN to obtain tailored crop recommendations based on production factors or product specifications.

3.6 Deployment Requirements

There are various requirements (hardware, software and services) to successfully deploy the system. These are mentioned below :

3.6.1 Hardware

32-bit or 64-bit Processing System: Refers to the type of processor architecture the system should have, either 32-bit or 64-bit.

Operating System: Windows 7 or later is required for the software to run properly.

Computer System: High processing power is recommended. Optionally, a GPU (Graphical Processing Unit) is suggested for enhanced performance.

3.6.2 Software

Python: A programming language used for developing applications, including machine learning and web-based projects.

Flask: A web framework for Python. Flask is used to build web applications, including web-based interfaces for machine learning models or other software systems.

Chapter 4
Implementation

In this project, an attempt has been made to highlight the role of Machine Learning in the field of Identifying the suitable crop for the desired soil by giving appropriate readings of the factors asked by the model .

4.1 Algorithm Used

4.1.1 RANDOM FOREST ALGORITHM :

Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique. It can be used for both Classification and Regression problems in ML. It is based on the concept of ensemble learning, which is a process of combining multiple classifiers to solve a complex problem and to improve the performance of the model. As the name suggests, "Random Forest is a classifier that contains a number of decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset." Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output. The greater number of trees in the forest leads to higher accuracy and prevents the problem of over fitting. Random Forest works in two-phase first is to create the random forest by combining N decision tree, and second is to make predictions for each tree created in the first phase.

The Working process can be explained in the below steps:

Step-1: Select random K data points from the training set.

Step-2: Build the decision trees associated with the selected data points.

Step-3: Choose the number N for decision trees that you want to build.

Step-4: Repeat Step 1 & 2.

Step-5: For new data points, find the predictions of each decision tree, and assign the new data points to the category that wins the majority votes.

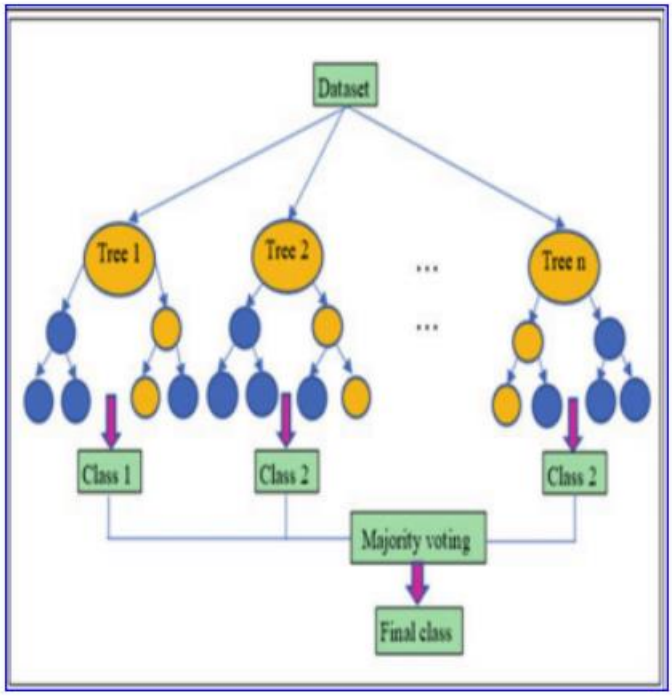

Figure 4-1: RANDOM FOREST ALGORITHM

4.1.2 DECISION TREE:

Decision Tree is a Supervised learning technique that can be used for both classification and Regression problems, but mostly it is preferred for solving Classification problems. It is a tree-structured classifier, whereNinternal nodes 18 represent the features of a dataset, branches represent the decision rules and each leaf nodeNrepresents the outcome. In a Decision tree, there are two nodes, which are the Decision Node and Leaf Node.Decision nodes are used to make any decision and have multiple branches, whereas Leaf nodes are the output of those decisions and do not contain any further branches. The decisions or the test are performed on the basis of features of the given dataset. It is a graphical representation for getting all the possible solutions to a problem/decision based on given conditions. It is called a decision tree because, similar to a tree, it starts with the root node, which expands on further branches and constructs a tree-like structure. In order to build a tree, we use the CART algorithm, which stands for Classification and Regression Tree algorithm. A decision tree simply asks a question, and based on the answer (Yes/No), it further

split the tree into subtrees.

The complete process can be better understood using the below algorithm:

Step-1: Begin the tree with the root node, says S, which contains the complete dataset.

Step-2: Find the best attribute in the dataset using Attribute Selection Measure (ASM)

Step-3: Divide the S into subsets that contains possible values for the best attributes.

Step-4: Generate the decision tree node, which contains the best attribute.

Step-5: Recursively make new decision trees using the subsets of the dataset created in step -3. Continue this process until a stage is reached where you cannot further classify the nodes and called the final node as a leaf node.

4.1.3 SUPPORT VECTOR MACHINE :

One SVM is a method of ML that generates an optimal hyperplane or decision boundary that can segregate dimensional spaces into classes, for the purpose of putting the new data in correct category in future. With the help of support vectors, we create hyperplane. The hyperplane thus generated has two support vectors each on either side of the hyperplane. The support vectors are nothing but lines that is drawn passing through two data points on either side, which is closest to hyperplane. The accuracy of this model is about 96.08 %. Thus, this model turns out to be more accurate than Random tree algorithm. The “Fig.7” is depiction of SVM classifier.

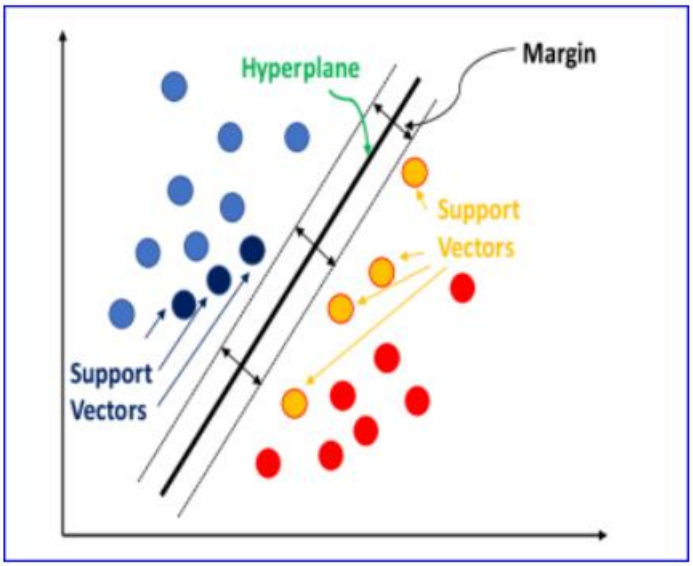

Figure 4-2: SUPPORT VECTOR MACHINE

4.1.4 LOGICAL REGRESSION:

MIDI, Logical regression is the one of the ML algorithm whose approach is to model bond between dependent along with independent variables. It is used to solve categorical data It is straightforward to implement and very fundamental and efficient model. The accuracy of logical regression model is 95.22 %. Its accuracy is better than random tree algorithm, but is lower than SVM. Thus, this model is discarded.

4.2 Tools Used

4.2.1 Flask

Flask's lightweight and opinionated design allows developers to choose the components that best suit their project needs, making it an ideal choice for those who prefer flexibility and simplicity in web development. Its lack of a database abstraction layer and form validation out of the box is compensated by the vibrant Flask ecosystem, where developers can seamlessly integrate widely-used third-party libraries tailored to their specific requirements.Moreover, Flask follows the WSGI (Web Server Gateway Interface) standard, enabling easy deployment on various web servers and platforms. Its minimalistic structure encourages rapid development, making it a popular choice for prototyping and building smaller applications. The Flask community actively contributes to the framework's growth, ensuring ongoing support, updates, and a wealth of resources for developers seeking to harness its capabilities.

4.3 Tech Stack

Python

Python is a simple and minimalistic language. Reading a good Python program feels almost like reading English (but very strict English!). This pseudocode nature of Python is one of its greatest strengths. It allows you to concentrate on the solution to the problem rather than the syntax i.e. the language itself. Python supports procedure-oriented programming as well as object-oriented programming. In procedure-oriented languages, the program is built around procedures or functions which are nothing but reusable pieces of programs. In object-oriented languages, the program is built around

objects which combine data and functionality. Python has a very powerful but simple way of doing object-oriented programming.

Flask:

Flask is a micro web framework written in Python. It is classified as a microframework because it does not require particular tools or librariesIt has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions that can add application features as if they were implemented in Flask itself. Extensions exist for object-relational mappers, form validation, upload handling, various open authentication technologies and several common framework related tools.

Javascript

JavaScript, often abbreviated as JS, is a programming language that is one of the core technologies of the World Wide Web, alongside HTML and CSS. As of 2023, 98.7% of websites use JavaScript on the client side for webpage behavior, often incorporating third-party libraries. All major web browsers have a dedicated JavaScript engine to execute the code on users' devices. JavaScript is a high-level, often just-in-time compiled language that conforms to the ECMAScript standard. It has dynamic typing, prototype-based object-orientation, and first-class functions. It is multi-paradigm, supporting event-driven, functional, and imperative programming styles. It has application programming interfaces (APIs) for working with text, dates, regular expressions, standard data structures, and the Document Object Model [DOM].

4.4 Testing

Testing is the process of evaluation of a system to detect differences between given input and expected output and also to assess the features of the system. Testing assesses the quality of the product. It is a process that is done during the development process. Tests can be conducted based on two approaches –

- Functionality testing
- Implementation testing

The testing method used here is Black Box Testing. It is carried out to test functionality

of the program. It is also called 'Behavioral' testing. The tester in this case, has a set of input values and respective desired results. On providing input, if the output matches with the desired results, the program is tested 'ok', and problematic otherwise.

Everything in this project is tested, testing was also done while making this project simultaneously and after making the project.

Integration Testing:

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects. The task of the integration test is to check that components or software applications, e.g. components in a software system or – one step up – software applications at the company level – interact without error. Test Results: All the test cases mentioned above passed successfully. No defects encountered.

Acceptance Testing:

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional Requirements. Test Results: All the test cases mentioned above passed successfully. No defects encountered.

4.4.1 Test Cases

Sr. No.	Feature	Description	Steps to Execute	Expected Output	Actual Output	Status
1	Form Validation	Verify presence of required fields: Nitrogen, Temperature, Rainfall, Phosphorus, Humidity, pH, Potassium	1.Navigate to the form	All required fields are present with labels	All required fields are present with labels	Passed
2	Tab Functionality	Ensure proper navigation using the Tab key	1. Start filling out the form	Ability to navigate through each field using the Tab key	Ability to navigate through each field using the Tab key	Passed
3	Enter/Tab key for Submit	Check if Enter/Tab key can substitute for the Submit button	1. Fill out all required fields	Pressing Enter/Tab submits the form	Pressing Enter/Tab submits the form	Passed
4	Placeholder Validity	Confirm that all fields have valid placeholders	1. Observe the form fields	Valid placeholders are present for all fields	Valid placeholders are present for all fields	Passed
5	Floating Label Behavior	Check if labels float upward when text field is focused or filled	1. Click on a text field to focus	Labels move upward when text field is focused or filled	Labels move upward when text field is focused or filled	Passed
6	Mandatory Field Marking	Verify that all required fields are marked with an asterisk (*)	1. Observe the form fields	Asterisk (*) is displayed next to all mandatory fields	Asterisk (*) is displayed next to all mandatory fields	Passed

7	Mandatory Field Validation	Confirm system generates validation message when mandatory fields are not filled	1. Click Submit without filling all mandatory fields	Validation message is displayed for unfilled mandatory fields	Validation message is displayed for unfilled mandatory fields	Passed
8	Blank Space Validation	Check if entering blank spaces in mandatory fields leads to validation error	1. Enter blank spaces in a mandatory field and click Submit	Validation error is displayed for fields with blank spaces	Validation error is displayed for fields with blank spaces	Passed
9	Optional Field Submission	Verify system submits data without validation error when optional fields are left empty	1. Fill out all mandatory fields and leave optional fields empty	Data is submitted without any validation error for optional fields left empty	Data is submitted without any validation error for optional fields left empty	Passed
10	Existing Username Validation	Ensure system generates validation message when entering an existing username	1. Enter a username that already exists in the system and click Submit	Validation message is displayed for existing username	Validation message is displayed for existing username	Passed
11	Business Requirement Validation	Check if all field validations align with business requirements	1. Fill out the form with various inputs	Validations are aligned with business requirements	Validations are aligned with business requirements	Passed

12	Email Field Validation	Verify system generates validation message for incorrect email format	1. Enter an incorrect email format and click Submit	Validation message is displayed for incorrect email format	Validation message is displayed for incorrect email format	Passed
13	Password Encryption	Confirm password is encrypted when entered	1. Enter a password	Password is displayed in encrypted format	Password is displayed in encrypted format	Passed
14	Password Match Validation	Check if system verifies whether password and confirm password fields match	1. Enter different values in password and confirm password fields and click Submit	Validation message is displayed if password and confirm password fields do not match	Validation message is displayed if password and confirm password fields do not match	Passed

4.4.2 Test Case and Analysis

Test Cases	Executed	Passed	Pending	Performance (positive/negative)
Crop recommendation form	100%	100%	0	Positive
Fertilizer Form	100%	100%	0	Positive
Home page	100%	99%	1%	Negative
Recommendatio -n Page	100%	100%	0	Positive

	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

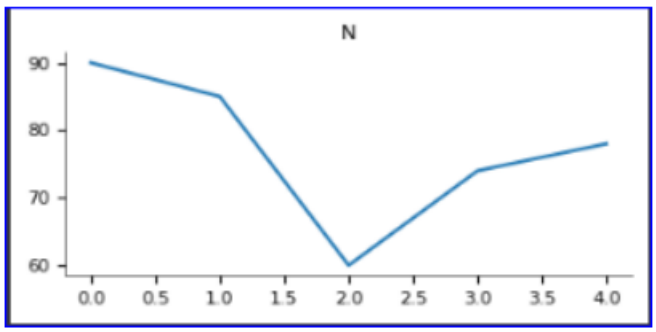

Figure 4-3 Test Case Analysis

Chapter 5
Conclusion

5.1 Conclusion

Agriculture is key to our country's economy, so even the smallest investment done in this sector has a tremendous effect on our country altogether. Therefore we need to be more serious about it. Due to the lack of scientific knowledge about different factors affecting crops, the farmers of our country tend to face a lot of challenges in selecting right crops to grow. Hence, face a loss in their profit, due to less productivity. But our system will provide them with a ray of hope to grow crops which will earn them at most profit. The quality as well as quantity of their production will increase exponentially. Also it will also help them in maintaining nutrients content in the soil. Both the quantity and quality will be increased The solution will benefit farmers to maximize productivity in agriculture, reduce soil degradation in cultivated fields, and reduce fertilizer use in crop production by recommending the right crop by considering various attributes. This would provide a comprehensive prediction on the basis of geographical, environmental and economic aspects.

5.2 Limitations of the Work

- Semantic Efficiency is low
- More number of repeated work.
- Not every farmer can use this model because of lack of education.

5.3 Suggestion and Recommendations for Future Work

- Should be develop in such a way that uneducated farmers can also use.
- Should be more accurate.

APPENDIX A: BIBLIOGRAPHY

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APPENDIX B: SOURCE CODE

app.py

```
from flask import Flask, render_template, request, Markup
import pandas as pd
import numpy as np
import sklearn
import os
import pickle
import warnings
from utils.fertilizer import fertilizer_dic


app = Flask(__name__)

loaded_model = pickle.load(open("models/model.pkl", 'rb'))


@app.route('/')
def home():
    return render_template('home.html')

@app.route('/fertilizer')
def fertilizer_recommendation():
    title = 'Fertilizer Suggestion'

    return render_template('fertilizer.html', title=title)


@ app.route('/fertilizer-predict', methods=['POST'])
def fert_recommend():
    title = 'Harvestify - Fertilizer Suggestion'

    crop_name = str(request.form['cropname'])
    N = int(request.form['nitrogen'])
    P = int(request.form['phosphorous'])
    K = int(request.form['pottasium'])
    # ph = float(request.form['ph'])

    df = pd.read_csv('Data/fertilizer.csv')
```

```
    nr = df[df['Crop'] == crop_name]['N'].iloc[0]
    pr = df[df['Crop'] == crop_name]['P'].iloc[0]
    kr = df[df['Crop'] == crop_name]['K'].iloc[0]

    n = nr - N
    p = pr - P
    k = kr - K
    temp = {abs(n): "N", abs(p): "P", abs(k): "K"}
    max_value = temp[max(temp.keys())]
    if max_value == "N":
        if n < 0:
            key = 'NHigh'
        else:
            key = "Nlow"
    elif max_value == "P":
        if p < 0:
            key = 'PHigh'
        else:
            key = "Plow"
    else:
        if k < 0:
            key = 'KHigh'
        else:
            key = "Klow"

    response = Markup(str(fertilizer_dic[key]))

    return render_template('fertilizer-result.html', recommendation=response,
title=title)




@app.route('/predict', methods=['POST'])
def predict():
    N = int(request.form['Nitrogen'])
    P = int(request.form['Phosporus'])
    K = int(request.form['Potassium'])
    temp = float(request.form['Temperature'])
    humidity = float(request.form['Humidity'])
    ph = float(request.form['pH'])
    rainfall = float(request.form['Rainfall'])
```

```
    feature_list = [N, P, K, temp, humidity, ph, rainfall]
    single_pred = np.array(feature_list).reshape(1, -1)

    prediction = loaded_model.predict(single_pred)

    crop_dict = {1: "Rice", 2: "Maize", 3: "Jute", 4: "Cotton", 5: "Coconut", 6:
"Papaya", 7: "Orange",
                 8: "Apple", 9: "Muskmelon", 10: "Watermelon", 11: "Grapes", 12:
"Mango", 13: "Banana",
                 14: "Pomegranate", 15: "Lentil", 16: "Blackgram", 17: "Mungbean", 18:
"Mothbeans",
                 19: "Pigeonpeas", 20: "Kidneybeans", 21: "Chickpea", 22: "Coffee"}

    if prediction[0] in crop_dict:
        crop = crop_dict[prediction[0]]
        # result = "{} is the best crop to be cultivated right there".format(crop)
        result = "{}".format(crop)

    else:
        result = "Sorry, we could not determine the best crop to be cultivated with
the provided data."

    return render_template('predict.html', prediction=result)


if __name__ == '__main__':
    app.run(debug=True)
```