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Cultivo A Machine Learning Based Crop Consultant

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Abstract. Agricultural monitoring, in particular in developing countries, can help prevent famineand support humanitarian efforts. A central challenge is yield estimation, which is to predict crop yields before harvesting. We introduce a scalable, accurate, and inexpensive method to predict crop yields using publicly available remote sensing data.This solution if implemented at the soil health centers which have been set up by the government could help all the farmers to use minimum fertilizers, so as to maintain thesoil health and also would provide them an opportunity to gain at most revenue from the same piece of land. Thus it would be a win-win for all the parties involved. This isprovided with the technologies such as Machine Learning and Image Processing. Machine Learning algorithm is used for prediction analysis i.e. to suggest the best cropand also the corresponding bio-fertilizer. Image Processing provides a technological base that could be used for further developmental projects in the field of automated drone or tractors as this generates a route through the field with the least number of turns. Predictive analysis to suggest the top three more suitable crop based on the nutrition levels of the soil, temperature and also the expected revenue that this particular crop could generate. There are two ways by which this could be used.

One would be the automatic way i.e. wherein the farmer just selects their location andbased on the previous test that were conducted at or near that place, a suitable crop would be suggested.

Second way is to manually enter the details relating to the soil and to obtain a suitablecrop for the entered in value.

Keywords: Agriculture, Crop, Fertilizer, Yield, farmer, Nutrition.

1 Introduction

1.1 About

The structure of data models in machine learning methods The main goal of agricultural planning is to achieve maximum yield rate of crops by using limitednumber of land resources. In our country large amount of population are depending on agriculture though government is taking financial steps to help farmers still they are facing problems due to lackof data anlaysis and prediction on crops. Our objective is to develop an application using machine learning for predicting which crop to be used based on soil condition using k nearest neighbor classification.It is estimated that 795 million people still live without an adequate food supply (FAO2015), and that by 2050 there will be two billion more people to feed (Dodds and Bartram 2016). Ending hunger and improving food security are primary goals in the 2030 Agenda for Sustainable Development of the United Nations (United Nations 2015). A central challenge to address food security issues is yield estimation, namely

being able to predict crop yields well before harvesting. Agricultural monitoring, in particular in developing countries, can improve food production and support humanitarian efforts in light of climate change and droughts (Dodds and Bartram 2016). Existing approaches rely on survey data and other variables related to crop growth (such as weatherand soil properties) to model crop yield. And selection of crops depends upon two things that is favourable and unfavourable conditions. This can also be improved by using hybridization methods.Many researches are carried out to improve agricultural planning. The goal is to get the maximum yield of crops. Many classification methods are also applied to get maximum yield of crops. Machinelearning techniques can be used to improve the yield rate of crops. The method of crop selection is applied to improve crop production. The production of crops may depend on geographical conditionsof the region like river ground, hill areas or the depth areas. Weather conditions like humidity, rainfall,temperature, cloud. Soil type may be clay, sandy, saline or peaty. Soil composition can be copper, potassium, phosphate, nitrogen, manganese, iron, calcium, ph value or carbon and different methodsof harvesting. Many parameters are used for different crops to do different predictions. These prediction models can be studied by using researches. These predictions are classified as two types. One is traditional statistic method and other is machine learning techniques. Traditional method helpsin predicting single sample spaces. And machine learning methods helps in predicting multiple predictions. We need not to consider the structure of data models in traditional method where as we need to consider

1.2 OBJECTIVES OF THE PROJECT

Agriculture is the field which plays an important role in improving our countries economy. Agriculture is the one which gave birth to civilization. India is an agrarian country and its economy largely based upon crop productivity. Hence we can say that agriculture can be backbone of all business in our country. Selecting of every crop is very important in the agriculture planning. The selection of crops will depend upon the different parameters such as market price, production rate and the different government policies. Many changes are required in the agriculture field to improvechanges in our Indian economy. We can improve agriculture by using machine learning techniques which are applied easily on farming sector. Along with all advances in the machines and technologies used in farming, useful and accurate information about different matters also plays a significant rolein it. 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 maximizingthe yield rate of crop production.

1.3 SCOPE OF THE PROJECT

In India, we all know that Agriculture is the backbone of the country. This paper predicts theyield of almost

all kinds of crops that are planted in India. This script makes novel by the usage of simple parameters like State, district, season, area and the user can predict the yield of the crop in which year he or she wants to. The paper uses advanced regression techniques like Kernel Ridge, Lasso and ENet algorithms to predict the yield and uses the concept of Stacking Regression for enhancing the algorithms to give a better prediction.

1.4 ADVANTAGES

1. The crop is suggested dependent on climatic conditions.

2. The Required Bio Fertilizers are suggested.

1.5 DISADVANTAGES

1.The result predicted is not 100% accurate and may vary when new training data.

2. In KNN Algorithm finding K value is difficult.

1.6 HARDWARE SOFTWARE REQUIREMENTS

HARDWARE REQUIREMENTS:

- System : Pentium IV 2.4 GHz.
- Hard Disk : 100 GB.
- Monitor : 15 VGA Color.
- Mouse : Logitech.
- RAM : MINIMUM 2 GB.

SOFTWARE REQUIREMENTS:

- Operating system : Windows XP/7/10
- Coding Language : Html, JavaScript,
- Development Kit : Flask Framework
- Programming language: Python

IDE : Anaconda prompt

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CHAPTER

LITERATURE SURVEY

2.1 Methodology

This application includes three parts. First is managing datasets second is testing datasets and third isanalyzing the datasets. In managing datasets, we can get the datasets of previous years and they can also be converted into supporting format as we are using Weka tool in this project all the datasets areconverted to attribute relation file format. In testing part we can do the single testing. We have considered this method of machine learning. One is K-Nearest neighbor method. In testing we can select any one of the methods and do testing of dataset like by selecting particular crop, particular place and particular season we can get results of yield. In analyzing part, we can input a whole datasetfile and get accuracy of the two different methods. This helps in predicting which method is good.

Here in this application we can do single testing by giving input as crop name, season selected and place selected. We can use any method among KNN method. As soon you give the input you can select the method and mine the results. The results will tell you the yield rate of that crop. And we can do multiple testing by analyzing the datasets. In analyzing it allows you to select a whole file at once and get the accuracy. Here instead of keep on doing single tests we can directly do the multipletesting. This testing helps in getting the accuracy between two methods. By this we will come to know which method is good among given methods. And this will help the farmers which crop to be selected for their land or the region. The datasets include the results of previous year data. These datasets help in predicting the results for new instances. Farmers can give any instance to the test andget the yield rate for the crop. So this application helps farmers to select the proper crop for land. Andit also helps them to predict the yield rate of selected crop. These methods can be implemented manually. Here we consider the probability values of instances. We can get the result for new instances. And we can predict whether the crop selected will give good yield or poor yield rate. Similarly, the KNN method will calculate the distance between two values given to the instances andfinds the minimum value.

2.2 EXISTING SYSTEM

Remote sensing data has been widely used for predicting crop yield in the remote sensing community(Bolton and Friedl 2013; Johnson 2014). However, all existing approaches we are aware of rely on hand-crafted features, on the assumption that they can capture most of the information related to vegetation growth contained in high dimensional images. Some widely used features include Normalized Difference Vegetation Index (NDVI) (Quarmby et al. 1993; Johnson 2014), two-band Enhanced Vegetation Index (EVI2) (Bolton and Friedl 2013) and N ormalized Difference Water Index(NDWI) (Satir and Berberoglu 2016).

2.3 PROPOSED SYSTEM

We can improve agriculture by using machine learning techniques which are applied easily on farming sector. Along with all advances in the machines and technologies used in farming, useful andaccurate information about different matters also plays a significant role in it. The concept of this paper is to implement the crop selection method so that this method helps in solving many agricultureand farmers problems. This improves our Indian economy by maximizing the yield rate of crop production.

Advantages

- Farmers can know which crop is feasible based on their soil type.
- Chances if increasing income for farmers based on analysis.

2.4 SYSTEM ANALYSIS

The **Systems Development Life Cycle (SDLC)**, or Software Development Life Cycle in systems engineering, information systems and software engineering, is the process of creating or altering systems, and the models and methodologies that people use to develop these systems.

In software engineering the SDLC concept underpins many kinds of software development methodologies. These methodologies form the framework for planning and controlling the creation of an information system the software development process.

SOFTWARE MODEL OR ARCHITECTURE ANALYSIS

Structured project management techniques (such as an SDLC) enhance management'scontrol over projects by dividing complex tasks into manageable sections. A software life cycle modelis either a descriptive or prescriptive characterization of how software is or should be developed. Butnone of the SDLC models discuss the key issues like Change management, Incident management andRelease management processes within the SDLC process, but, it is addressed in the overall project management. In the proposed hypothetical model, the concept of user-developer interaction in the conventional SDLC model has been converted into a three dimensional model which comprises of the user, owner and the developer. In the proposed hypothetical model, the concept of user-developerinteraction in the conventional SDLC model has been converted into a three dimensional model whichcomprises of the user, owner and the developer. The ―one size fits all‖ approach to applying SDLCmethodologies is no longer appropriate. We have made an attempt to address the above mentioned defects by using a new hypothetical model for SDLC described elsewhere. The drawback ofaddressing these management processes under the overall project management is missing of key technical issues pertaining to software development process that is, these issues are talked in the project management at the surface level but not at the ground level.

2.5 SDLC METHODOLOGIES

This document play a vital role in the development of life cycle (SDLC) as it describes the complete requirement of the system. It means for use by developers and will be the basic during testing phase. Any changes made to the requirements in the future will have to go through formal change approval process.

SPIRAL MODEL was defined by Barry Boehm in his 1988 article, "A spiral Model of Software Development and Enhancement. This model was not the first model to discuss iterative development, but it was the first model to explain why the iteration models.

As originally envisioned, the iterations were typically 6 months to 2 years long. Each phase starts with a design goal and ends with a client reviewing the progress thus far. Analysis and engineering efforts are applied at each phase of the project, with an eye toward the end goal of the project.

The following diagram shows how a spiral model acts like

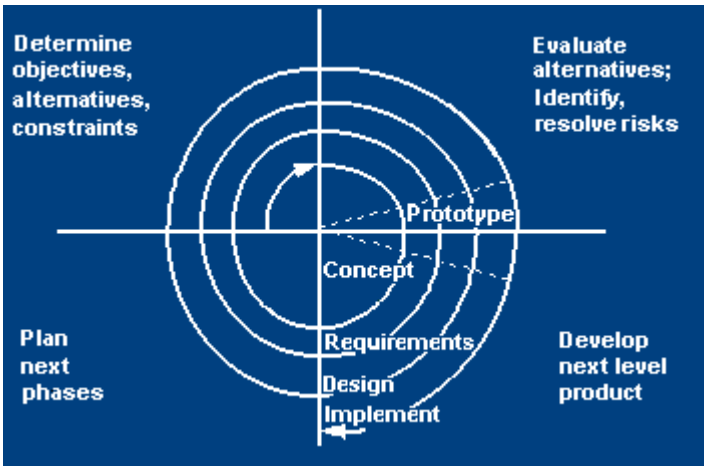

Fig 2.5 SDLC METHODOLOGIE

The steps for Spiral Model can be generalized as follows:

The new system requirements are defined in as much details as possible. This usually involves interviewing a number of users representing all the external or internal users andother aspects of the existing system.

- A preliminary design is created for the new system.
- A first prototype of the new system is constructed from the preliminary design. This is usually a scaled-down system, and represents an approximation of the characteristics of the final product.
- A second prototype is evolved by a fourfold procedure:
- Evaluating the first prototype in terms of its strengths, weakness, and risks.
- Defining the requirements of the second prototype.
- Planning a designing the second prototype.
- Constructing and testing the second prototype.
- At the customer option, the entire project can be aborted if the risk is deemed too great. Risk factors might involve development cost overruns, operating-cost miscalculation, or any other factor that

could, in the customer's judgment, result in a less-than-satisfactory final product.

- The existing prototype is evaluated in the same manner as was the previous prototype, andif necessary, another prototype is developed from it according to the fourfold procedure outlined above.
- The preceding steps are iterated until the customer is satisfied that the refined prototype represents the final product desired.
- The final system is constructed, based on the refined prototype.
- The final system is thoroughly evaluated and tested. Routine maintenance is carried on a continuing basis to prevent large scale failures and to minimize down time.

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CHAPTER

PROPOSED ARCHITECTURE

3.1 SYSTEM ARCHITECTURE

The purpose of the design phase is to arrange an answer of the matter such as by the necessity document. This part is that the opening moves in moving the matter domain to the answer domain. The design phase satisfies the requirements of the system. The design of a system is probably the foremost crucial issue warm heartedness the standard of the software package. It's a serious impacton the later part, notably testing and maintenance.

The output of this part is that the style of the document. This document is analogous to a blueprint of answer and is employed later throughout implementation, testing and maintenance. The design activity is commonly divided into 2 separate phases System Design and Detailed Design.

System Design conjointly referred to as top-ranking style aims to spot the modules that ought to bewithin the system, the specifications of those modules, and the way them move with one another tosupply the specified results.

At the top of the system style all the main knowledge structures, file formats, output formats, and also the major modules within the system and their specifications square measure set. System designis that the method or art of process the design, components, modules, interfaces, and knowledge fora system to satisfy such as needs. Users will read it because the application of systems theory to development.

Detailed Design, the inner logic of every of the modules laid out in system design is determined. Throughout this part, the small print of the info of a module square measure sometimes laid out in a high-level style description language that is freelance of the target language within which the software package can eventually be enforced.

In system design the main target is on distinguishing the modules, whereas throughout careful stylethe main target is on planning the logic for every of the modules.

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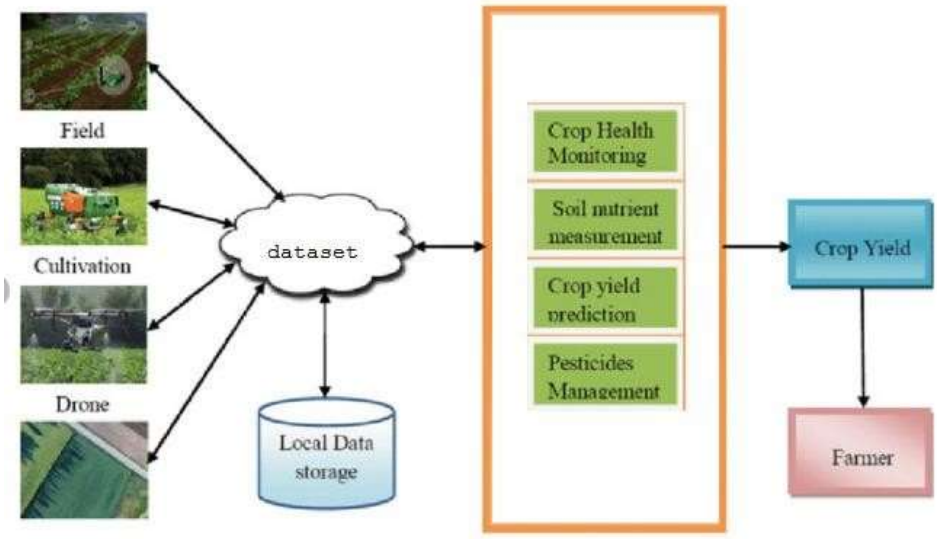

Fig 3.1: Architecture diagram

Here first we collect the data sets and process the data and we remove if there are any impurities in the data sets. Next the data is normalized if needed like it can be converted to smaller volume of data.Next the data is converted to supporting format. And then it is stored in the databases. Next the required method is applied. Now we get the final results.

3.2 INPUT AND OUTPUT DESIGN

3.2.1 INPUT DESIGN

Input design is a part of overall system design. The main objective during the input design is as givenbelow:

- To produce a cost-effective method of input.
- To achieve the highest possible level of accuracy.

- To ensure that the input is acceptable and understood by the user.

INPUT STAGES

The main input stages can be listed as below:

- Data recording
- Data transcription
- Data conversion
- Data verification
- Data control
- Data transmission
- Data validation
- Data correction

INPUT TYPES

It is necessary to determine the various types of inputs. Inputs can be categorized as follows:

- External inputs, which are prime inputs for the system.
- Internal inputs, which are user communications with the system.
- Operational, which are computer department's communications to the system?
- Interactive, which are inputs entered during a dialogue.

INPUT MEDIA

At this stage choice has to be made about the input media. To conclude about the input mediaconsideration has to be given to;

- Type of input
- Flexibility of format
- Speed
- Accuracy
- Verification methods
- Rejection rates
- Ease of correction
- Storage and handling requirements
- Security
- Easy to use
- Portability

Keeping in view the above description of the input types and input media, it can be said thatmost of the inputs are of the form of internal and interactive. As

Input data is to be the directly keyed in by the user, the keyboard can be considered to be the mostsuitable input device.

3.2.2 OUTPUT DESIGN

Outputs from computer systems are required primarily to communicate the results of processing to users. They are also used to provide a permanent copy of the results for later consultation. The varioustypes of outputs in general are:

- External Outputs, whose destination is outside the organization
- Internal Outputs whose destination is within organization and they are the
- User's main interface with the computer.

- Operational outputs whose use is purely within the computer department.
- Interface outputs, which involve the user in communicating directly.

OUTPUT DEFINITION:

The outputs should be defined in terms of the following points:

- Type of the output
- Content of the output
- Format of the output
- Location of the output
- Frequency of the output
- Volume of the output
- Sequence of the output

It is not always desirable to print or display data as it is held on a computer. It should bedecided as which form of the output is the most suitable.

3.3 SOFTWARE REQUIREMENT SPECIFICATION

What is SRS?

Software Requirement Specification (SRS) is the starting point of the software developing activity. As system grew more complex it became evident that the goal of the entire system cannot be easily comprehended. Hence the need for the requirement phase arose. The software project is initiated by the client needs. The SRS is the means of translating the ideas of the minds of clients (the input) into a formal document (the output of the requirement phase.

The SRS phase consists of two basic activities:

Problem/Requirement Analysis

The process is order and more nebulous of the two, deals with understand the problem, the goal and constraints.

Requirement Specification

Here, the focus is on specifying what has been found giving analysis such as representation, specification languages and tools, and checking the specifications are addressed during this activity. The Requirement phase terminates with the production of the validate SRS document.Producing the SRS document is the basic goal of this phase.

Role of SRS:

The purpose of the Software Requirement Specification is to reduce the communication gap between the clients and the developers. Software Requirement Specification is the medium though which the client and user needs are accurately specified. It forms the basis of software development.A good SRS should satisfy all the parties involved in the system.

Scope:

Automatic mode converter is an Android application for automatic profile switching. This application helps the user to schedule his profiles so that the user will be able to switch his device tothe 'Silent Mode' automatically by default and there will be no need to set them manually. This application is also user friendly in which the user can schedule his profile so that, it can switch to 'user defined profile mode' by using user defined settings.

3.4 UML CONCEPTS

Data Flow Diagram can also be termed as bubble chart. It is a pictorial or graphical form, which can be applied to represent the input data to a system and multiple functions carried out on thedata and the generated output by the system.

A graphical tool accustomed describe and analyze the instant of knowledge through a systemmanual or automatic together with the method, stores of knowledge, and delays within the system. The transformation of knowledge from input to output, through processes, is also delineate logicallyand severally of the physical

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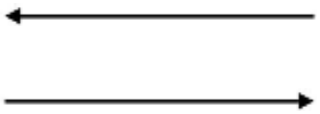
elements related to the system. The DFD is also known as a data flow graph or a bubble chart. The Basic Notation used to create a DFD's are as follows:

- **Dataflow:**



Process:

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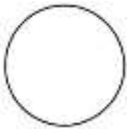
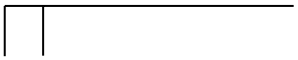


- **Source:**

- **Data Store:**



- **Rhombus:** decision

UML DIAGRAMS

The Unified Modeling Language allows the software engineer to express an analysis model using themod-eling notation that is governed by a set of syntactic semantic and pragmatic rules.

A UML system is represented using five different views that describe the system from distinctly

different perspective. Each view is defined by a set of diagrams, which is as follows.

User Model View

This view represents the system from the user's perspective. The analysis representation describes ausage scenario from the end-user's perspective.

Structural Model view

In this model the data and functionality are arrived from inside the system. This model view modelsthe static structures.

Behavioral Model View

It represents the dynamic of behavioral as parts of the system, depicting the interactions of collection between various structural elements described in the user model and structural model view.

Implementation Model View

In this the structural and behavioral as parts of the system are represented as they are to be built.

3.4.1 USE CASE DIAGRAM

A use case diagram at its simplest is a representation of a user's interaction with the system and depicting the specifications of a use case. A use case diagram can portray the different types of users of a system and the various ways that they interact with the system. This type of diagram is typically used in conjunction with the textual use case and will often be accompanied by other typesof diagrams as well.

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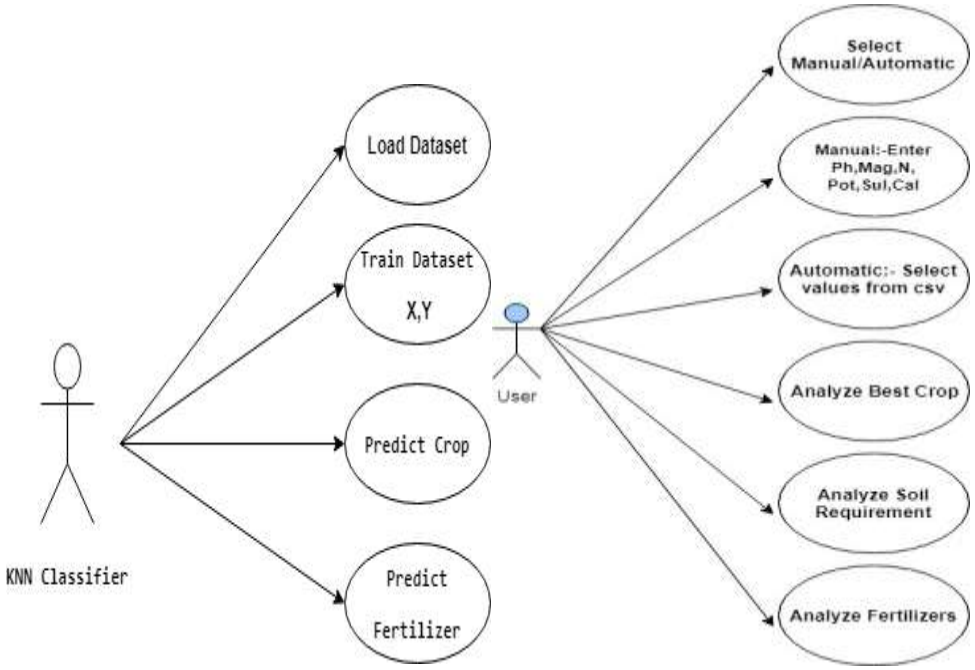

Fig 3.4.1 Use Case Diagram

3.4.2 CLASS DIAGRAM

The class diagram is the main building block of object-oriented modeling. It is used both for general conceptual modeling of the systematic of the application, and for detailed modeling translating the models into programming code. Class diagrams can also be used for data modeling. The classes in aclass diagram represent both the main objects, interactions in the application and the classes to be programmed. A class with three sections, in the diagram, classes is represented with boxes which contain three parts:

The upper part holds the name of the class

The middle part contains the attributes of the class

The bottom part gives the methods or operations the class can take or undertake.

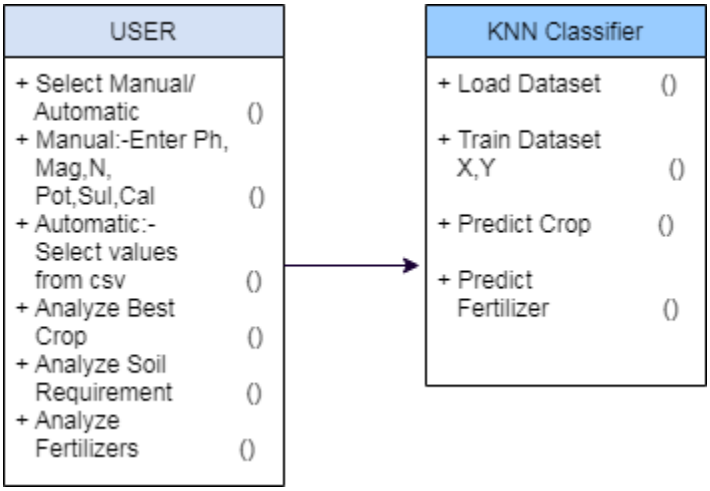

Fig 3.4.2: Class Diagram

3.4.3 SEQUENCEDIAGRAM

A sequence diagram is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the Logical View of the system under development. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

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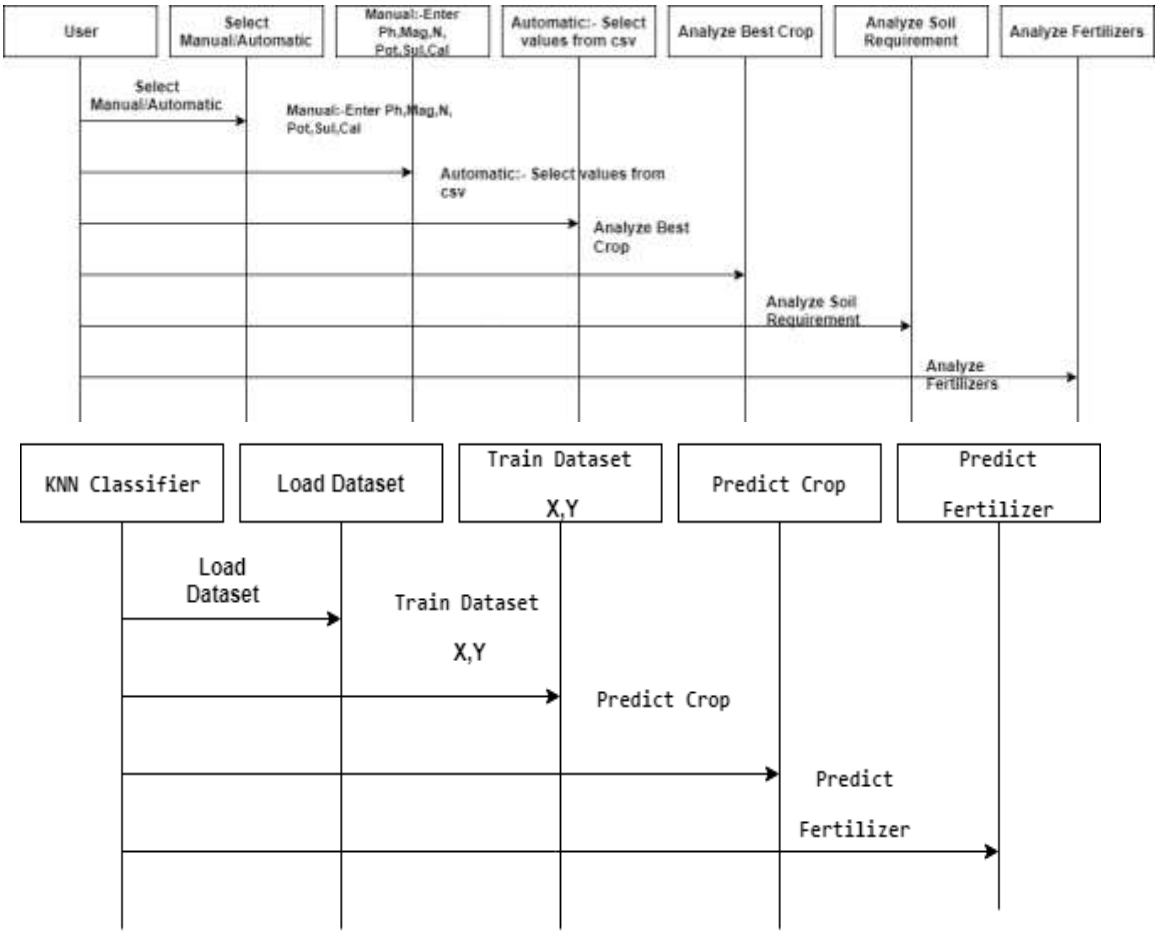

Fig 3.4.3: Sequence Diagram

3.4.4 ACTIVITY DIAGRAM

Activity diagrams are graphical representations of workflows of stepwise activities and actions withsup-port for choice, iteration and concurrency. In the Unified Modeling Language, activity diagramscan be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

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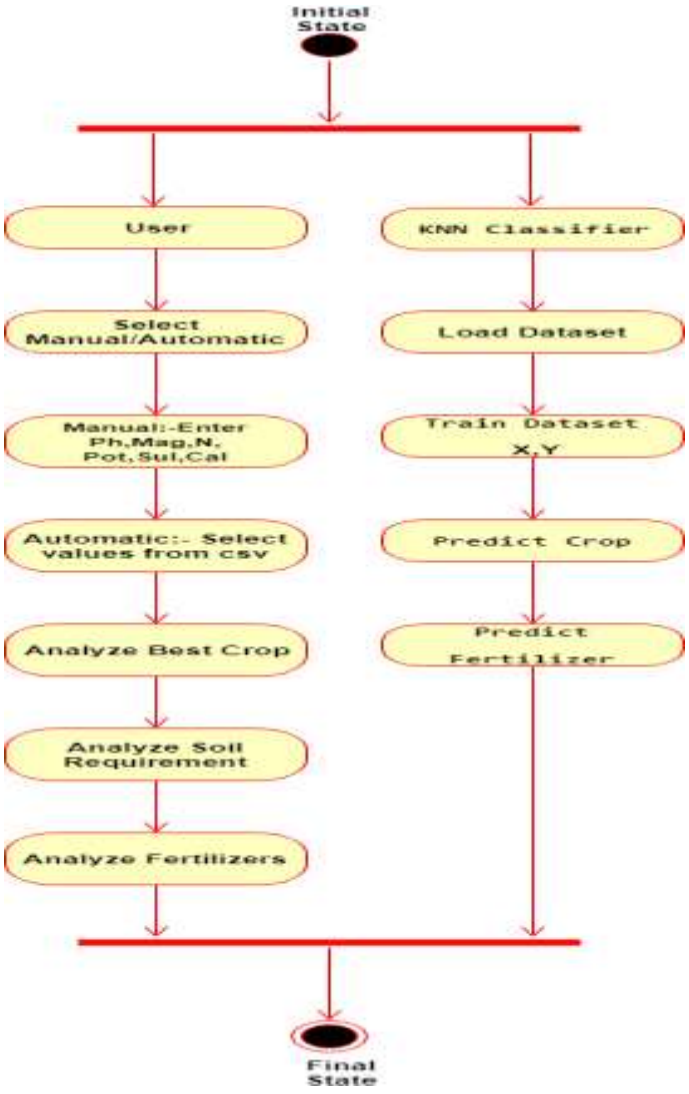

3.4.5 Component Diagram

Component diagram is a special kind of diagram in UML. The purpose is also different from all other diagrams discussed so far. It does not describe the functionality of the system but it describesthe components

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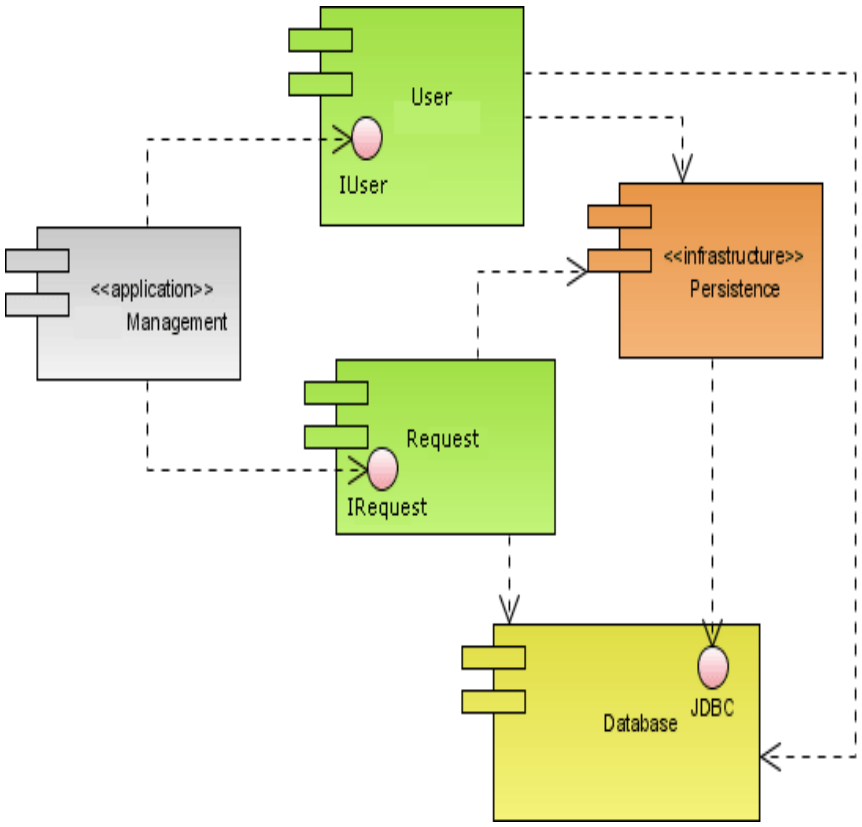
used to make those functionalities.



3.4.6 Deployment Diagram

Deployment diagram shows the configuration of run time processing nodes and the components ofthe application. It is a kind of structure diagram used in modeling the physical aspects of an objectoriented system.

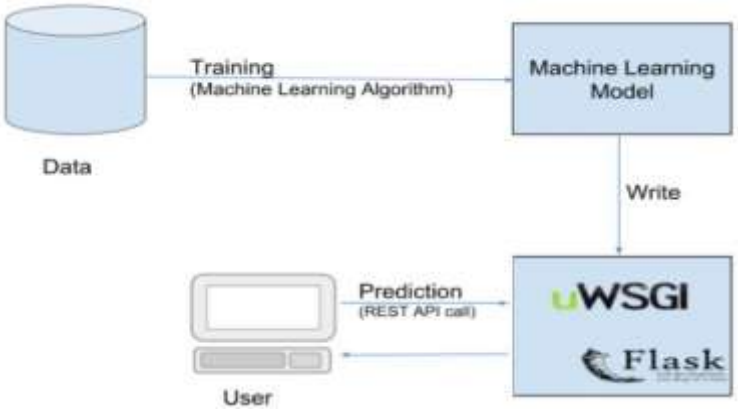


Figure 3.4.6: Deployment Diagram

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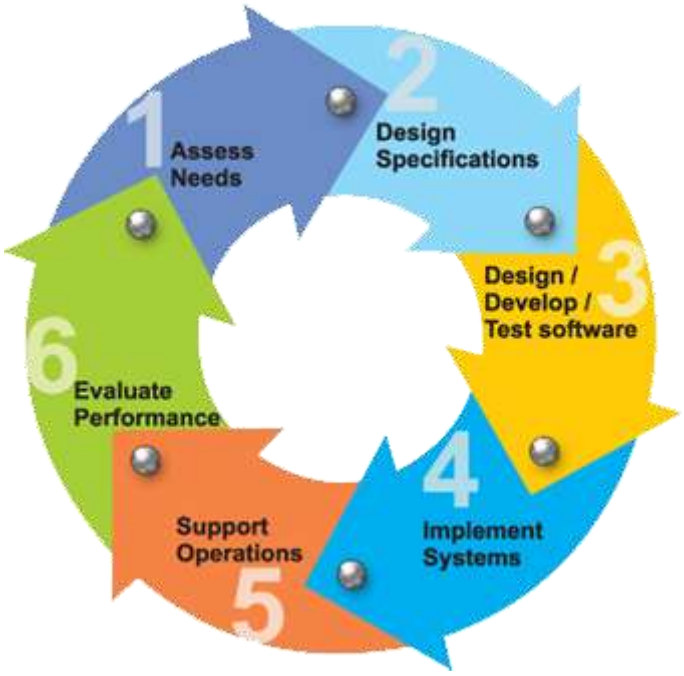
CHAPTER

IMPLEMENTATION

4.1 INTRODUCTION

Software Development Life Cycle

There is various software development approaches defined and designed which are used/employed during development process of software, these approaches are also referred as "Software Development Process Models". Each process model follows a



output by the system? These are generalquestions that get answered during a requirements gathering phase. This produces a nice big list of functionality that the system should provide, which describes functions the system should perform, business logic that processes data, what data is stored and used by the system, and

how the user interface should work. The overall result is the system as a whole and how it performs, not how it isactually going to do it.

Design:

The software system design is produced from the results of the requirements phase. Architects have the ball in their court during this phase and this is the phase in which their focus lies. This is where the details on how the system will work is produced. Architecture, includinghardware and software, communication, software design (UML is produced here) are all part of the deliverables of a design phase.

Implementation:

Code is produced from the deliverables of the design phase during implementation, and this is the longest phase of the software development life cycle. For a developer, this is the main focus of the life cycle because this is where the code is produced. Implementation my overlap with both the design and testing phases. Many tools exists (CASE tools) to actually automate the production of code using information gathered and produced during the design phase.

Testing:

During testing, the implementation is tested against the requirements to make sure that the product is actually solving the needs addressed and gathered during the requirements phase. Unit tests and system/acceptance tests are done during this phase. Unit tests act on a specific componentof the system, while system tests act on the system as a whole.
So in a nutshell, that is a very basic overview of the general software development life cycle model.

4.2 Data Preprocessing

Data Preprocessing is a technique that is used to convert the raw data into a clean data set. In other words, whenever the data is gathered from different sources it is collected in raw format which is not feasible for the analysis.

In the final dataframe there are two categorical columns in the dataframe, categorical data are variables that contain label values rather than numeric values. The number of possible values is oftenlimited to a fixed set, like in this case, items and countries values. Many machine learning algorithmscannot operate on label data directly, they require all input variables and output variables to be numeric.

This means that categorical data must be converted to a numerical form. **One hot encoding** is a process by which categorical variables are converted into a form that could be provided to ML algorithms to do a better job in prediction. For that purpose, One-Hot Encoding will be used to convertthese two columns to one-hot numeric array.

The categorical value represents the numerical value of the entry in the dataset. This encoding will create a binary column for each category and returns a matrix with the results.

	average_rain_fall_mm_per_year	pesticides_tonnes	avg_temp	Country_Albania	Country_Algeria	Country_Angola	Country_Argentina	Country_Armenia
0	1485.0	121.0	16.37	1	0	0	0	0
1	1485.0	121.0	16.37	1	0	0	0	0
2	1485.0	121.0	16.37	1	0	0	0	0
3	1485.0	121.0	16.37	1	0	0	0	0
4	1485.0	121.0	16.37	1	0	0	0	0

Fig 4.2:DATA PREPROCESSING

The features of the dataframe will look like the above with 115 columns. Taking a look at the dataset above, it contains features highly varying in magnitudes, units and range. The features with high magnitudes will weigh in a lot more in the distance calculations than features with low magnitudes. To suppress this effect, we need to bring all features to the same level of magnitudes. This can beachieved by scaling with MinMaxScaler.

The final step on data preprocessing is the training and testing data. The dataset will be split into two datasets, the training dataset and test dataset. The data usually tend to be split inequality because training the model usually requires as much data-points as possible.The common splits are 70/30 or 80/20 for train/test.

The training dataset is the initial dataset used to train ML algorithms to learn and produce right predictions. (70% of dataset is training dataset)

Model Comparison & Selection

Pre-processing

For the given data set, there are quite a few 'NA' values which are filtered in python. Furthermore, as the data set consists of numeric data, we used robust scaling, which is quite similar to normalization, but it instead uses the interquartile range whereas normalization is something which normalization shrinks the data in terms of 0 to 1. B.

Testing and training

This is a kind of assembling but a little of enhancement of averaging. In this, we add a meta model and use the out of fold predictions of the other models used to train the main meta model.

Step-1: the total training set is again divided into two different sets. (train and holdout)

Step-2: train the selected base models with first part (train).

Step-3: Test them with the second part. (holdout)

Step-4: Now, the predictions obtained from test part are inputs to the train higher level learner calledmeta-model. Iteratively, the first three steps are completed. For example, if we take a 5-fold stacking,we divide the training data into 5 folds first. We'll the we take a 5-fold stacking,we divide the training data into 5 folds first. We'll then do 5 iterations. We train each base model on4 folds in each iteration and predict the remaining fold (holdout fold). So, after 5 iterations, we'll be confident that all the data will be used to get out - of-fold predictions that we'll use as a new feature in

Step 4 to train our meta-model. We average the predictions of all base models on the test data for thepredictive portion and used them as meta-features on which the meta-model is finally predicted. Here,our meta model is KNN.

Data Pre-Processing

Data Pre-processing is the first step of research methodology. In this work, dataset is authorized fromthe UCI repository. In this step, the input value data is being noise free. This means that error valuesare segregated from the dataset.

Feature Extraction: The second step is Over-fitting should be avoided as an important objective of feature selection. The performance of model can be improved. This process can be gives the relation between each and every features of the data with the predestined target data set.

Classification: The KNN classification can be implemented on given dataset. The paddy production prediction will be originate by classification stage. SVM is mainly imperative for non separable training data sets. Some slack variables are established to manage the nonlinear separable cases. Some training errors could be handled using this phenomenon. This classifier waits till the lastminute prior to build some model on a specified tuple as compared to earlier classifiers. KNN algorithm can be implemented easily. This algorithm performs quickly in case of small data sets. However, this algorithm performs slowly on huge amount of data and big size data. This approach isresponsive to the value of k.

4.3 KNN Classifier Algorithm

K-nearest neighbor method can be used for both regression and classification predictive problems. This method helps in interpret output, calculate time and predictive power. The Machine learning techniques are used in various fields. KNN is also one of the machine learning method. This is also called as method of sample-based learning. This will contain the data of past datasets and can be usedwhile predicting the new datasets. This will apply function called as distance function like Manhattanor Euclidean distance. This can be used to compute distance from samples to all other training samples. It calculates the target value for new samples. The target vale will be the weighted sum of target values of the k nearest neighbours. The valve of K can be directly proportional to the prediction.Whenever the valve of K is small this indicates there is high variance and there is low bias. If the valve of the K is larger than this indicates that there is low variance and high bias. The main advantageof this KNN is it does not require any training or the optimization. This KNN uses data samples whenpredicting the new datasets. Hence it is having higher complexity and also more time consumption.

Prediction of Crop Yield through K-NN

This work represents a review of K-NN technique for the early prediction of cropyield. K-NN analysisis used for predicting the unknown parameter from the known parameters. In this work we are considering rainfall, temperature, humidity and soil moisture as input parameters which are the mainparameters to be considered for a good crop yield, although there are many other factors that can be considered. The unknown value of crop yield can be predicted from the nearest known values of thenearest neighbors by calculation of Euclidean distance between them. Then we would be able to predict crop yield for given rainfall, temperature, humidity and soil moisture parameters. To measurethe distance between points in a feature space, various distance functions can be used, in which the Euclidean distance function is the most widely used one. Let p and q are represented as feature vectors. To calculate the distance between p and q, the Euclidean metric is generally used by if a=(a1,a2) and b=(b1,b2) then the distance is given by

Datasets

The data sets of different districts of the Telangana state are collected from Telangana State Development Planning Society. The important factors that determine the crop yield are temperature,humidity, soil moisture and rainfall. The samples contain daily recorded data of the above-mentionedfactors and soil moisture of about depth of 4 inches. These samples are taken for the month of May 2019. These factors for every district in Telangana state are collected for one week and the crop yieldis being predicted by using

Machine learning technique. KNN algorithm is used to classify and predictthe crop yield. All the available data set is divided into a window of five among which four are the input factors to the prediction model and fifth one is crop yield. Among the data set available maximum of the data is used for training and the remaining data is used for testing. The machine learning technique KNN algorithm is used for prediction of crop yield.

Learning algorithm

The k-nearest neighbor (k-NN) method is a data mining technique considered to be among the top five techniques for data mining. The method k-NN uses the common definition of "Cicero pares cumparibus facillim e congregantur" (birds of a feather flock together or literally equals with equalseasilyassociate). It attains the properties of new variable with the help of properties of existing variables. Itis applicable in classification as well as regression problems. It endeavors to characterize an obscure

example dependent on the known characterization of its neighbors. Give us a chance to assume that a lot of tests with realized grouping is accessible, the alleged preparing set. Naturally, each exampleought to be grouped comparably to its encompassing examples. In this way, on the off case that the order of an instance is obscure, by observing the ordering of its nearest neighbor tests it could be expected at that point. Depending on an obscure example and a set of preparations, each of the separations between the obscure example and each of the instances in the collection of preparations can be interpreted. The division with the least esteem is compared to the instance in the preparation that is nearest to the possess sample unidentified. Therefore, the obscure example might be ordered dependent on the characterization of this closest neighbor. So with respect to the application of KNNalgorithm towards prediction of crop yield, the nearest neighbors of a particular point(crop yield) liketemperature, humidity, rainfall and soil moisture are considered, if these factors have the enough values required for a crop yield then it can be considered as a good crop yield depending on the factors. We can implement KNN by using the below mentioned steps:

- Load the data set.
- Initialize the 'k' value
- For getting the anticipated class, repeat from one to all the numbers of training data set.
- Compute the distance between test data and each line of training information. Here the Euclidean distance is utilized, since it's the most prominent technique. Differentmeasurements that can be utilized are Chebyshev, cosine, and so forth.

RELATED WORK

Forecasting agriculture product plays a significant role in agriculture planning. It helps in making product storage, business strategy and risk management. There are two methods to forecast agriculture product in advance. First is statistics method such as Autoregressive Integrate Moving Average (ARIMA) and Holt-Winter and second is machine learning method such as Support vector machine and artificial neural network. These methods are comparatively study over Thailand's pacific white shrimp export data and Thailands. Produced chicken data using support vector machineand ARIMA model.Where support vector method gives more accurate result than ARIMA. Moreover, machine learning methods are convenient to implement and comparably faster than statics methods. Indian agriculture is highly dependent on summer rainfall. The correlation between summerrainfall and agriculture product production is studied.

This paper presents an analysis of crop-climate relationship using past crops data. Correlation analysistells that the monsoon rainfall, Pacific and Indian Ocean sea-surface temperatures and Darwin sea- level pressure directly influence the crop production in India. Result shows that the state-level crop production statistics and sub divisional monsoon rainfall are consistent with the all-India result, except few cases. Moreover, the impact of sub divisional monsoon rainfall related to El Niosouthernoscillation and the Indian Ocean sea-surface temperatures have seen long time a greatest impact in the western to central peninsula. A famine prediction application is modeled using machine learningtechnique.Predicting the famine for a region early is used to mitigate the vulnerability of the societyat risk. Machine learning techniques are experimented on past data collected between 2004 and 2005in Uganda. The performance of machine learning methods named Support Vector Machine (SVM), Naive Bayes, k-Nearest Neighbors (k-NN) and Decision tree classifier in prediction of famine were assessed empirically.SVM and k-NN methods give better result than the rest of the methods, moreover the region of convergence produced by Support Vector Machine can be used by strategic planner in cut-off determination of famine prone management. An UChooBoost machine learning method is modeled for precision agriculture. The emerging technology in agricul- ture field needs toprocess large amount of digital information related to agriculture field. The UChooBoost is a supervised learning ensemble-based algorithm used for knowledge mining in agriculture data. UChooclassifier is used as base classifier in bootstrap ensemble. A combination of weighted major- ity voting is used for performance evaluation in precision agriculture. UChooBoost is empirically evaluated for an extended data and it shows good performance in experiment with agriculture data.

The strongest trait of using UChooBoost is to apply for an extended data expression and works on compounding hypotheses which leads to improve algorithm performance. Artificial neural network is used as

crop yield prediction by sensing various parameters of climate and soil. Parameters are water depth, soil type, temperature, presser, rainfall, humidity, nitrogen, phosphate, potassium and organic carbon. The impact of these parameters are studied and empirically assessed in paper. It is observed that the production rate of crop is correlated with atmospheric parameter, soil type and soilcomposition. This paper also suggests suitable crop based on prediction of crop yield rate in advance.Artificial neural network is used as powerful tool for modeling and prediction of crop yield rate andimprove the effectiveness of crop yield prediction. Agriculture product depends on climatic, geographical, biological, political and economic factors. Since these factors are highly sensitive, thereare some risks which can be measured appropriately. These risks can be quantified mathematically or using learning technique. The accurate information about factors influencing crop yield isimportant for both farmer and government of the country.

Prediction of crop yield based on historical data plays a significant role to mitigate vulnerable risk. The main challenges in agriculture data are to process these huge raw data effectively and accu- rately. Artificial neural network is a learning technique used to mine knowledge of meaningful information from raw data effectively and efficiently. The paper aimed to assess a data mining technique and apply them to big raw data-sets to correlate crop yield rate and influencing factors as mentioned earlier. An intelligent tool for rice yield prediction is developed using statistics and machine learning techniques. This tool is used in classification and clustering. Support vector machine learning technique is used for classification or rice plantation data. Kernel based clusteringalgorithm is used for finding cluster in climate data. Kernel methods are applicable for complex, highdimensional and non-linearly separable data. Correlation analysis is performed for evaluating the impact of various influencing parameters on the rice yield and regression analysis is performed for predicting the crop yield rate. Support vector machine is used for noisy data. These features makes tool as an intelligent system for predicting rice yield. Machine learning techniques are widely used in crop yield prediction. There are many learning techniques proposed for crop yield prediction, andcomparatively studied by many researchers seeking for the most accurate technique. But due to the less number of evaluated crops and techniques, an appropriate decision cannot be achieved. A comparative analysis is performed for large number of evaluated crops and technique in the paper. The result shows accuracy percentage of different learning technique on the collected data set and thepaper suggest some learning technique for crop yield prediction for different crop data-sets.

The production rate of crop in China is studied by splitting whole region of China into six different regions. Using combination of historical crop yield record, meteorological observations, and 28 CMIP5 (Coupled Model Intercomparison Project Phase 5) ensemble methods, to evaluate impact offuture climate change on crop yields. CMIP5 is a statistics method to build a prediction model. It is seemed that the crop yields in Northwest and Southwest China are positively correlated with temperature change and little crop (e.g. soybean) production in Northwest depends on precipitation;where as, in East and Central-South China,

these crops are positively correlated with both precipitation and temperature change. However, there is no any significant correlation between crop yield and climate parameter in North and Northeast China except for few crops such as wheat as wellas rice production in North China is weakly correlated with temperature and soybean production withtemperature in Northeast China. It is observed empirically that the spatial pattern among the four crops (e.g. wheat, rice, soybean, maize), the sensitivity to temperature changes increasing from Northto South China.

4.4 Modules

Dataset collection

In this stage data set is prepared which has temperature, humidity, potassium. Nitrogen,phosphorus, along with labels 1 to 7 and crops details.

Preprocessing Algorithm training

In this stage data is collected from dataset and divided to testing and training and given inputto algorithm and fit to algorithm.

User Module

In this stage user gives input of all features from website and get output as which crop isbest and yield for each crop.

4.5 STUDY OF THE SYSTEM

In the flexibility of uses the interface has been developed a graphics concepts in mind, associated through a browser interface. The GUI's at the top level has been categorized as follows

1.Administrative User Interface Design

2. The Operational and Generic User Interface Design

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The administrative user interface concentrates on the consistent information that is practically,part of the organizational activities and which needs proper authentication for the data collection. The Interface helps the administration with all the transactional states like data insertion, data deletion, and data updating along with executive data search capabilities.

The operational and generic user interface helps the users upon the system in transactions through the existing data and required services. The operational user interface also helps the ordinary users in managing their own information helps the ordinary users in managing their own information in acustomized manner as per the assisted flexibilities.

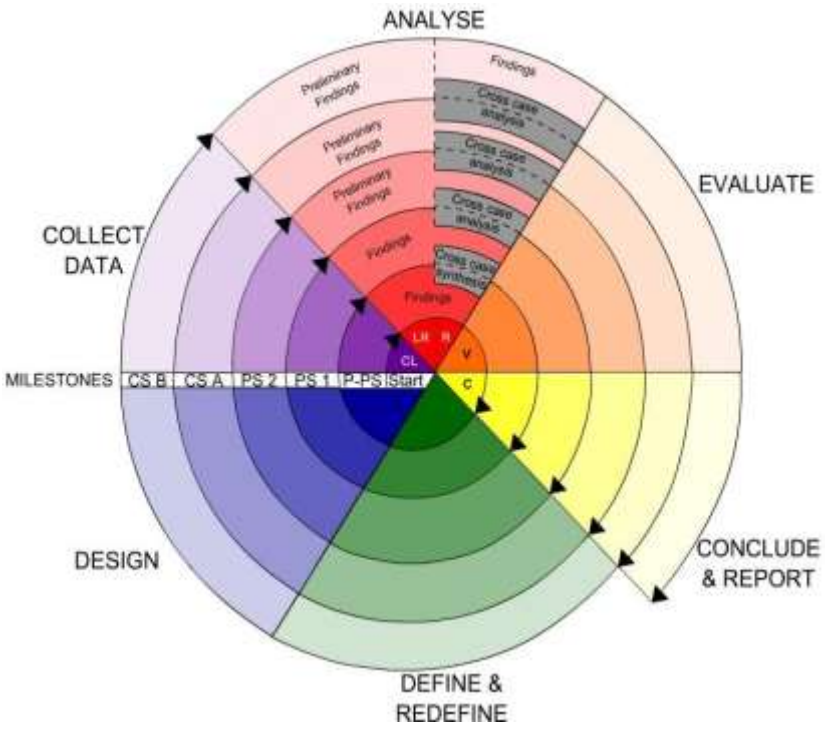

Fig 4.5 STUDY OF THE SYSTEM

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4.6 TESTING CODE

As indicated above, code is usually developed in a file using an editor.To test the code, import it into a Python session and try to run it.

Usually there is an error, so you go back to the file, make a correction, and test again.

This process is repeated until you are satisfied that the code works. The entire process is known as the development cycle.

There are two types of errors that you will encounter. Syntax errors occur when the form of somecommand is invalid.

This happens when you make typing errors such as misspellings, or call something by the wrong name, and for many other reasons. Python will always give an error message for a syntax error.

SAMPLE CODE

```
  from flask import Flask , render_template , request , redirect ,
url_forapp = Flask(__name__)

  _code = ""
  @app.route("/users/index",             meth-
ods=["GET","POST"])def main():
  return render_template('index.html')

  @app.route("/users/graph",             meth-
ods=["GET","POST"])def login():
  return render_template('chart.html')

  @app.route("/users/logs",            meth-
ods=["GET","POST"])def logs():
  return render_template('logs.html')

  @app.route("/users/analyse/predict", methods=["GET","POST"])def pre-
dict():
  import pandas as pd
  fertilizer_data = pd.read_excel("optimum2.xlsx", 'biofertilizer')X =
fertilizer_data.drop("CLASS",axis=1)
  y = fertilizer_data.CLASS
```

```
  pred = pd.read_excel('optimum2.xlsx', 'Sheet3') pred = pred.drop(["pH"
, "Temperature"] , axis=1) from sklearn.neighbors import KNeighborsClas-
sifierclf = KNeighborsClassifier(n_neighbors=1) clf.fit(X,y)
  prediction1 = clf.predict(pred)print(prediction1)

  if(prediction1[0] == 1):
            return render_template("fertilizer.html" , fertilizer="Azo-
tobacter                        Bacillus_circulans      Pisolithus_sp")
  elif(prediction1[0] == 2):
            return render_template("fertilizer.html" , fertilizer="Azo-
tobacter                        Bacillus_circulans      Sclero-
cystis_sp")
  elif(prediction1[0] == 3):
            return render_template("fertilizer.html" , fertilizer="Azo-
tobacter,                       Bacillus_circulans,     Acau-
lospora_sp")
  elif(prediction1[0] == 4):
            return render_template("fertilizer.html" , fertilizer="Azo-
tobacter, Pseudomonas_striata, Pisolithus_sp")
  elif(prediction1[0] == 5):
            return render_template("fertilizer.html" , fertilizer="Azo-
tobacter,                       Pseudomonas_striata, Sclerocystis_sp")
  elif(prediction1[0] == 6):
            return render_template("fertilizer.html" , fertilizer="Azo-
tobacter,                       Pseudomonas_striata, Acaulospora_sp")
  elif(prediction1[0] == 7):
            return render_template("fertilizer.html" , fertilizer="Azo-
tobacter,                       Penicillium_sp, Pisolithus_sp")
  elif(prediction1[0] == 8):
            return render_template("fertilizer.html" , fertilizer="Azo-
tobacter,                       Penicillium_sp, Sclerocystis_sp")
  elif(prediction1[0] == 9):
            return render_template("fertilizer.html" , fertilizer="Azo-
tobacter,                       Penicillium_sp, Acaulospora_sp")
  elif(prediction1[0] == 10):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Frankia,  Bacillus_circulans,             Pisolithus_sp")
  elif(prediction1[0] == 11):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Frankia,  Bacillus_circulans,             Sclerocystis_sp")
  elif(prediction1[0] == 12):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Frankia,  Bacillus_circulans,             Acaulospora_sp")
  elif(prediction1[0] == 13):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Frankia,  Pseudomonas_striata, Pisolithus_sp")
  elif(prediction1[0] == 14):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Frankia,  Pseudomonas_striata, Sclerocystis_sp")
```

```
  elif(prediction1[0] == 15):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Frankia,  Pseudomonas_striata, Acaulospora_sp")
  elif(prediction1[0] == 16):
            return    render_template("fertilizer.html"    ,   ferti-
lizer="Frankia,  Penicillium_sp, Pisolithus_sp")
  elif(prediction1[0] == 17):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Frankia,  Penicillium_sp, Sclerocystis_sp")
  elif(prediction1[0] == 18):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Frankia,  Penicillium_sp, Acaulospora_sp")
  elif(prediction1[0] == 19):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Anabaena, Bacillus_circulans, Pisolithus_sp")
  elif(prediction1[0] == 20):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Anabaena, Bacillus_circulans, Pisolithus_sp")
  elif(prediction1[0] == 21):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Anabaena, Bacillus_circulans, Pisolithus_sp")
  elif(prediction1[0] == 22):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Anabaena, Pseudomonas_striata, Pisolithus_sp")
  elif(prediction1[0] == 23):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Anabaena, Pseudomonas_striata, Sclerocystis_sp")
  elif(prediction1[0] == 24):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Anabaen,  Pseudomonas_striata, Acaulospora_sp")
  elif(prediction1[0] == 25):
            return      render_template("ferti-
lizer.html"   , fertilizer="Anabaena,   Penicil-
lium_sp, Pisolithus_sp")
  elif(prediction1[0] == 26):
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Anabaena, Penicillium_sp, Sclerocystis_sp")
  else:
            return    render_template("fertilizer.html"    ,    ferti-
lizer="Anabaena, Penicillium_sp, Acaulospora_sp")

  @app.route("/users/analyse", methods=["POST"])def analyse():
  if(request.method == "POST"):import pandas as pd import numpy as np
  # import os
  optimum    =    pd.read_excel("optimum2.xlsx",    'newData')    price    =
pd.read_excel("optimum2.xlsx",    'pricePerhr')  optimum['N']    =    opti-
mum.N.astype(float)
  optimum['P']    =    optimum.P.astype(float)  optimum['K']    =    opti-
mum.K.astype(float)
```

```
  optimum['TEMPERATURE'] = optimum.TEMPERATURE.astype(float)
  X = optimum.drop("CLASS",axis=1)y
= optimum.CLASS

  from sklearn.neighbors import KNeighborsClassifierclf =
KNeighborsClassifier(n_neighbors=3) clf.fit(X,y)

  print(request.form.get('Potassium')) if(request.form.get('Potassi-

um') == None):

  pred = pd.read_excel('optimum2.xlsx', 'Sheet3')

  prediction     =     clf.predict(pred)
print(prediction)

  optimum = optimum[optimum['CLASS'] != prediction[0]]X = opti-
mum.drop("CLASS",axis=1)
  y = optimum.CLASS
  clf     =     KNeighborsClassifier(n_neighbors=3)
clf.fit(X,y)
  prediction1     =     clf.predict(pred)
print(prediction1)


  optimum  =  optimum[optimum['CLASS']  !=  prediction1[0]] X  =  opti-
mum.drop("CLASS",axis=1)
  y = optimum.CLASS
  clf = KNeighborsClassifier(n_neighbors=3)clf.fit(X,y)
  prediction2 = clf.predict(pred)print(prediction2)
  p1 = prediction1[0]p2 = prediction2[0]p1 = p1 -1
  p2 = p2 -1
  # print()

  if(prediction == 7):
  return render_template('crops.html' , crop="TOMATO"
  ,       crop1=prediction1[0]       ,       crop2=prediction2[0]       ,
price=price["Price/hr"].iloc[6]   ,price1=price["Price/hr"].iloc[p1]   ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 1):
  return render_template('crops.html' , crop="GARLIC"
  ,       crop1=prediction1[0]       ,       crop2=prediction2[0]       ,
price=price["Price/hr"].iloc[[0]]  ,price1=price["Price/hr"].iloc[p1]  ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 2):
  return render_template('crops.html' , crop="ONION"
  , crop1=prediction1[0] , crop2=prediction2[0] ,
  price=price["Price/hr"].iloc[[1]] , price1=price["Price/hr"].iloc[p1]
,price2=price["Price/hr"].iloc[p2])
```

```
  elif(prediction == 3):
  return render_template('crops.html' , crop="ORANGE"
  ,       crop1=prediction1[0]       ,       crop2=prediction2[0]       ,
price=price["Price/hr"].iloc[[2]] , price1=price["Price/hr"].iloc[p1] ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 4):
                        return      render_template('crops.html'      ,
crop="PEAS"    ,  crop1=prediction1[0]    ,    crop2=prediction2[0]    ,
price=price["Price/hr"].iloc[[3]] , price1=price["Price/hr"].iloc[p1] ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 5):
  return render_template('crops.html' , crop="POTATO"
  ,       crop1=prediction1[0]       ,       crop2=prediction2[0]       ,
price=price["Price/hr"].iloc[[4]] , price1=price["Price/hr"].iloc[p1] ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 6):
                       return      render_template('crops.html'      ,
crop="RICE"    ,  crop1=prediction1[0]    ,    crop2=prediction2[0]    ,
price=price["Price/hr"].iloc[[5]] , price1=price["Price/hr"].iloc[p1] ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 8):
  return render_template('crops.html' , crop="SUGARCANE" , crop1=predic-
tion1[0] , crop2=prediction2[0] , price=price["Price/hr"].iloc[[7]] ,
price1=price["Price/hr"].iloc[p1] ,price2=price["Price/hr"].iloc[p2])
  else:

  return "no"


  potassium   =   request.form.get('Potassium')   phosphorous   =   re-
quest.form.get('Phosphorous')nitrogen = request.form.get('Nitrogen')
  pH = request.form.get('pH')
  temperature = request.form.get('Temperature')

  columns = ['N','P','K','pH','TEMPERATURE']
  values = np.array([ nitrogen ,phosphorous ,potassium , pH ,tempera-
ture])
  pred = pd.DataFrame(values.reshape(-1,len(values)),columns=columns)

  # print(pred.dtype)print(pred)

  prediction = clf.predict(pred)print(prediction)

  optimum  =  optimum[optimum['CLASS']  !=  prediction[0]] X  =  opti-
mum.drop("CLASS",axis=1)
  y = optimum.CLASS
  clf = KNeighborsClassifier(n_neighbors=3)


  clf.fit(X,y)
```

```
  prediction1 = clf.predict(pred)print(prediction1)


  optimum = optimum[optimum['CLASS'] != prediction1[0]] X = opti-
mum.drop("CLASS",axis=1)
  y = optimum.CLASS
  clf = KNeighborsClassifier(n_neighbors=3)clf.fit(X,y)
  prediction2 = clf.predict(pred)print(prediction2)

  p1 = prediction1[0]p2 = prediction2[0]p1 = p1 -1
  p2 = p2 -1

  # print()

  if(prediction == 7):
  return render_template('crops.html' , crop="TOMATO"
  ,       crop1=prediction1[0]       ,       crop2=prediction2[0]       ,
price=price["Price/hr"].iloc[6]   ,price1=price["Price/hr"].iloc[p1]   ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 1):
  return render_template('crops.html' , crop="GARLIC"
  ,       crop1=prediction1[0]       ,       crop2=prediction2[0]       ,
price=price["Price/hr"].iloc[0]   ,price1=price["Price/hr"].iloc[p1]   ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 2):
  return render_template('crops.html' , crop="ONION"
  ,       crop1=prediction1[0]       ,       crop2=prediction2[0]       ,
price=price["Price/hr"].iloc[1]  ,  price1=price["Price/hr"].iloc[p1]  ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 3):
  return render_template('crops.html' , crop="ORANGE"
  ,       crop1=prediction1[0]       ,       crop2=prediction2[0]       ,
price=price["Price/hr"].iloc[2]  ,  price1=price["Price/hr"].iloc[p1]  ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 4):
                       return      render_template('crops.html'      ,
crop="PEAS"    ,  crop1=prediction1[0]    ,    crop2=prediction2[0]    ,
price=price["Price/hr"].iloc[3]  ,  price1=price["Price/hr"].iloc[p1]  ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 5):
  return render_template('crops.html' , crop="POTATO"
  ,       crop1=prediction1[0]       ,       crop2=prediction2[0]       ,
price=price["Price/hr"].iloc[4]  ,  price1=price["Price/hr"].iloc[p1]  ,
price2=price["Price/hr"].iloc[p2])
  elif(prediction == 6):
  return  render_template('crops.html'  ,  crop="RICE"  , crop1=predic-
tion1[0]  ,  crop2=prediction2[0]  ,  price=price["Price/hr"].iloc[5]  ,
price1=price["Price/hr"].iloc[p1] ,price2=price["Price/hr"].iloc[p2])
  elif(prediction == 8):
```

```
  return render_template('crops.html' , crop="SUGARCANE" , crop1=predic-
tion1[0]  ,  crop2=prediction2[0]  ,  price=price["Price/hr"].iloc[7]  ,
price1=price["Price/hr"].iloc[p1] ,price2=price["Price/hr"].iloc[p2])
  else:
  return "no"
  # render_template('index.html')else:
  return render_template('index.html')

  if (__name____== "__main__"): app.run(host='127.0.0.1', debug=True,
port=8000)
```

Index.html

```
  <!DOCTYPE html>



  <script type="text/javascript">var centerlat , centerlong;
  var  staticMapUrl  =  "https://maps.googleapis.com/maps/api/staticmap";
function myMap() {
  var cordinateslt = [];var cordinateslg = [];var loclat , loclng ; var
cordinates = [];
  var num = cordinates.length;
  var map,location,mapCanvas,mapOptions;

  if (navigator.geolocation) {
  navigator.geolocation.getCurrentPosition(function(position) {loclat =
position.coords.latitude;
  loclng = position.coords.longitude;
  location = new google.maps.LatLng(loclat , loclng);mapCanvas = docu-
ment.getElementById("map");
  mapOptions = {center: location, zoom: 16};
  map  =  new  google.maps.Map(mapCanvas,mapOptions);  map.setMapTyp-
eId(google.maps.MapTypeId.SATELLITE);


  function setpoly(){

  for(var i=0;i<num;i++)
  {
            cordinates.push(new  google.maps.LatLng(cordinateslt[i]  ,
cordinateslg[i]));
  }
  cordinates.pop(); map.setCenter(cordinates[num-1]);

flightPath = new google.maps.Polygon({path:cordinates,
  strokeColor: "#0000FF",strokeOpacity: 0.8,
```

```
  strokeWeight: 2, fillColor: "#0000FF",fillOpacity: 0.4
  });
  flightPath.setMap(map);    google.maps.event.clearListen-
ers(map,    "rightclick");   google.maps.event.clearListen-
ers(map, "click");
  }

  google.maps.event.addListener(map, "rightclick", function(event) {
var lat = event.latLng.lat();
  var lng = event.latLng.lng();
cordinateslt.push(lat);  cordi-
nateslg.push(lng);
  num = num + 1;
setpoly(); center-
long = lng;center-
lat = lat;
  staticMapUrl += "?center=" + centerlat + "," + centerlong;staticMa-
pUrl += "&size=220x300";
  staticMapUrl += "&zoom=" + 18;
  staticMapUrl += "&maptype=" + google.maps.MapTypeId.SATELLITE;


  });

  google.maps.event.addListener(map, "click", function(event) {
var lat = event.latLng.lat();
  var lng = event.latLng.lng();
cordinateslt.push(lat);  cordi-
nateslg.push(lng);
  num = num + 1;
  });


  });
  }
  }

  </script>
```

Login.html

```
  <html>
  <head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width , initial-scale=1.0"
  >
  <meta name="description" content="Fertilizer Prediction">
  <meta name="author" content="Mayank Singh">
  <script
```

```
  src="https://ajax.goog-
leapis.com/ajax/libs/jquery/3.2.1/jquery.min.js"><
  /script>
  <script  type="text/javascript"  src="https://maxcdn.boot-
strapcdn.com/font-awesome/4.7.0/css/font-               awe-
some.min.css"></script>
  <script  type="text/javascript"  href="{{  url_for('static',file-
name='bootstrap.min.js')    }}"    rel="stylesheet"   media="screen">
</script>
  <script  type="text/javascript"  href="{{  url_for('static',file-
name='login2_js.js') }}" rel="stylesheet"media="screen"></script>

  <script  type="text/javascript"  src="https://maxcdn.boot-
strapcdn.com/font-awesome/4.7.0/css/font-               awe-
some.min.css"></script>
  <link href="{{ url_for('static',filename='styles/bootstrap.min.css')
  }}" rel="stylesheet" media="screen">
  <link  href="{{  url_for('static',filename='styles/login2_css.css')
}}"rel="stylesheet" media="screen">
  <link  href="{{  url_for('static',filename='styles/index_css.css')
}}"rel="stylesheet" media="screen">
  <link  href="{{  url_for('static',filename='styles/indexstyle.css')
}}"rel="stylesheet" media="screen">
  </head>
  <body>

  <div class="container">
  <nav class="navbar navbar-inverse navbar-fixed-top">
  <div class="navbar-header">
  <a class="navbar-brand" href="#">Precision Farming</a>
  </div>
  <ul class="nav navbar-nav">
  <li id="nav1"><a href="/users/index">Home</a></li>
  <!-- <li id="nav2"><a href="/users/logs">Logs</a></li> -->
  <!--     <li     id="nav3"><a     href="/users/graph">Graphs</a></li>

--
  >
  </ul>

  </nav>


  </div>
  <div id="map" style="width:100%;height:500px;margin-top:-40px"></div>
```

```
  <script                                src="https://maps.goog-
leapis.com/maps/api/js?key=AIzaSyDnHwu2ZwEb9a-
SRj07HK3rRBA_H3ZSgRI&callback=myMap"></script>
  <div class="wrapper container-fluid">
  <div class="row well" style="min-height: 100px">
  <div class="row">
  <div class ="col-sm-12 col-centered" style="padding-bottom:    1em">
          <center><div class="btn-group center">
                 <button    id    ="manual_btn"    type="button"
class="btn btn-primary active small">Manual</button>
                 <button     id="auto_btn"     type="button"
class="btn btn-primary">Automatic</button>
              </div>
          </center>
        </div>
      </div>
  <form action="/users/analyse" method="POST">
     <div class="row" style="padding-bottom: 0.5em , margin-
left : -30px">
         <div class = "col-md-2">
           <div class="input-group">
               <span class="input-group-addon">Nitrogen</i></span>
             <input id="input_value3" type="text" class="form-
control"name="Nitrogen" placeholder="Enter Nitrogen Value">
             </div>
           </div>
           <div class = "col-md-3">
           <div class="input-group">
               <span class="input-group-addon">Phosphorous</i></span>
             <input id="input_value2" type="text" class="form-
control"  name="Phosphorous"   placeholder="Enter   Phosphorous
Value">
             </div>
           </div>

         <div class ="col-md-2">
           <div class="input-group">
               <span class="input-group-addon">Potassium</i></span>
             <input id="input_value1" type="text" class="form-
control"name="Potassium" placeholder="Enter Potassium Value">
              </div>
         </div>

           <div class = "col-md-2">
           <div class="input-group">
               <span class="input-group-addon">pH</i></span>
             <input id="input_value4" type="text" class="form-
control"name="pH" placeholder="Enter pH Value">
       </div>
```

```
</div>
<div class = "col-md-3">
<div class="input-group">
<span class="input-group-addon">Temperature</i></span>
<input id="input_value5" type="text" class="form-control"name="Temperature"
placeholder="Enter Temperature Value">
</div>
</div>
</div>
</div>
</div>

<div class="wrapper container-fluid" style="margin-bottom : 10px">
<div class="row">
<div class="col-md-12 text-right">
<!-- <button type="button" class="btn btn-primary nav_btn"><iclass="fa fa-stop
icn" aria-hidden="true"></i>Stop</button> -->


<button type="submit" href="/users/analyse" class="btn btn-primary nav_btn"
><i class="fa fa-play icn" aria- hidden="true"></i>Analyse</button>
</form>

</div>
</div>
        </div>
  <td>
  <img id="imgMap" alt="" style="display: none" /></td>
<input type="button" id="btnExport" value="Export" onclick="Export()"/>

</body>
</html>
<script type="text/javascript">
$(function() {
$("#manual_btn").click(function(){
$('#input_value1').removeAttr("disabled");
$('#input_value2').removeAttr("disabled");
$('#input_value3').removeAttr("disabled");
$('#input_value4').removeAttr("disabled");
$('#input_value5').removeAttr("disabled");
$('#auto_btn').removeClass("active");
$('#manual_btn').addClass("active");
  });

$("#auto_btn").click(function(){
$('#input_value1').attr("disabled" , "true");
$('#input_value2').attr("disabled" , "true");
$('#input_value3').attr("disabled" , "true");
```

```
  $('#input_value4').attr("disabled" , "true");
  $('#input_value5').attr("disabled" , "true");
  $('#auto_btn').addClass("active");
  $('#manual_btn').removeClass("active");
  });
  });

  </script>

  <script
type="text/javas-
cript"> function   Ex-
port() {
  //URL of Google Static Maps.
  // var staticMapUrl = "https://maps.googleapis.com/maps/api/stat-
icmap";

  // //Set the Google Map Center.
  // staticMapUrl += "?center=" + centerlat + "," + centerlat;

  // //Set the Google Map Size.
  // staticMapUrl += "&size=220x350";

  // //Set the Google Map Zoom.
  // staticMapUrl += "&zoom=" + 16;//mapOptions.zoom;

  // //Set the Google Map Type.
  // staticMapUrl += "&maptype=" + //mapOptions.mapTypeId;

  // //Loop and add Markers.
  // for (var i = 0; i < markers.length; i++) {
  //               staticMapUrl  +=  "&markers=color:red|"  +  mark-
ers[i].lat +"," + markers[i].lng;
  // }

  //Display the Image of Google Map.
console.log(staticMapUrl);
  var    imgMap    =    document.getElementById("imgMap");
imgMap.src = staticMapUrl;
  imgMap.style.display = "block";
  }
   </script>
```

4.7 SAMPLE TESTING

Testing is the process where the test data is prepared and is used for testing the modules individually and later the validation given for the fields. Then the system testing takes place which makes sur that all

components of the system property function as a unit. The test data should be chosen such that it passed through all possible condition. The following is the description of the testing strategies, which were carried out during the testing period.

4.8 SYSTEM TESTING

Testing has become an integral part of any system or project especially in the field of information technology. The importance of testing is a method of justifying, if one is ready to move further, beit to be check if one is capable to with stand the rigors of a particular situation cannot beunderplayed and that is why testing before development is so critical. When the software is developed before it is given to user to user the software must be tested whether it is solving the purpose for which it is developed. This testing involves various types through which one can ensurethe software is reliable. The program was tested logically and pattern of execution of the program for a set of data are repeated. Thus the code was exhaustively checked for all possible correct dataand the outcomes were also checked.

4.9 MODULE TESTING

To locate errors, each module is tested individually. This enables us to detect error and correct it without affecting any other modules. Whenever the program is not satisfying the required function,it must be corrected to get the required result. Thus all the modules are individually tested from bottom up starting with the smallest and lowest modules and proceeding to the next level. Each module in the system is tested separately. For example the job classification module is tested separately. This module is tested with different job and its approximate execution time and the result of the test is compared with the results

that are prepared manually. Each module in the system is tested separately. In this system the resource classification and job scheduling modules are tested separately and their corresponding results are obtained which reduces the process waiting time.

4.10 INTEGRATION TESTING

After the module testing, the integration testing is applied. When linking the modules there may bechance for errors to occur, these errors are corrected by using this testing. In this system all modulesare connected and tested. The testing results are very correct. Thus the mapping of jobs with resources is done correctly by the system

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4.11 ACCEPTANCE TESTING

When that user fined no major problems with its accuracy, the system passers through a final acceptance test. This test confirms that the system needs the original goals, objectives and requirements established during analysis without actual execution which elimination wastage of time and money acceptance tests on the shoulders of users and management, it is finally acceptableand ready for the operation

CHAPTER

RESULT

Fig 5.1: Analyze page before entering values

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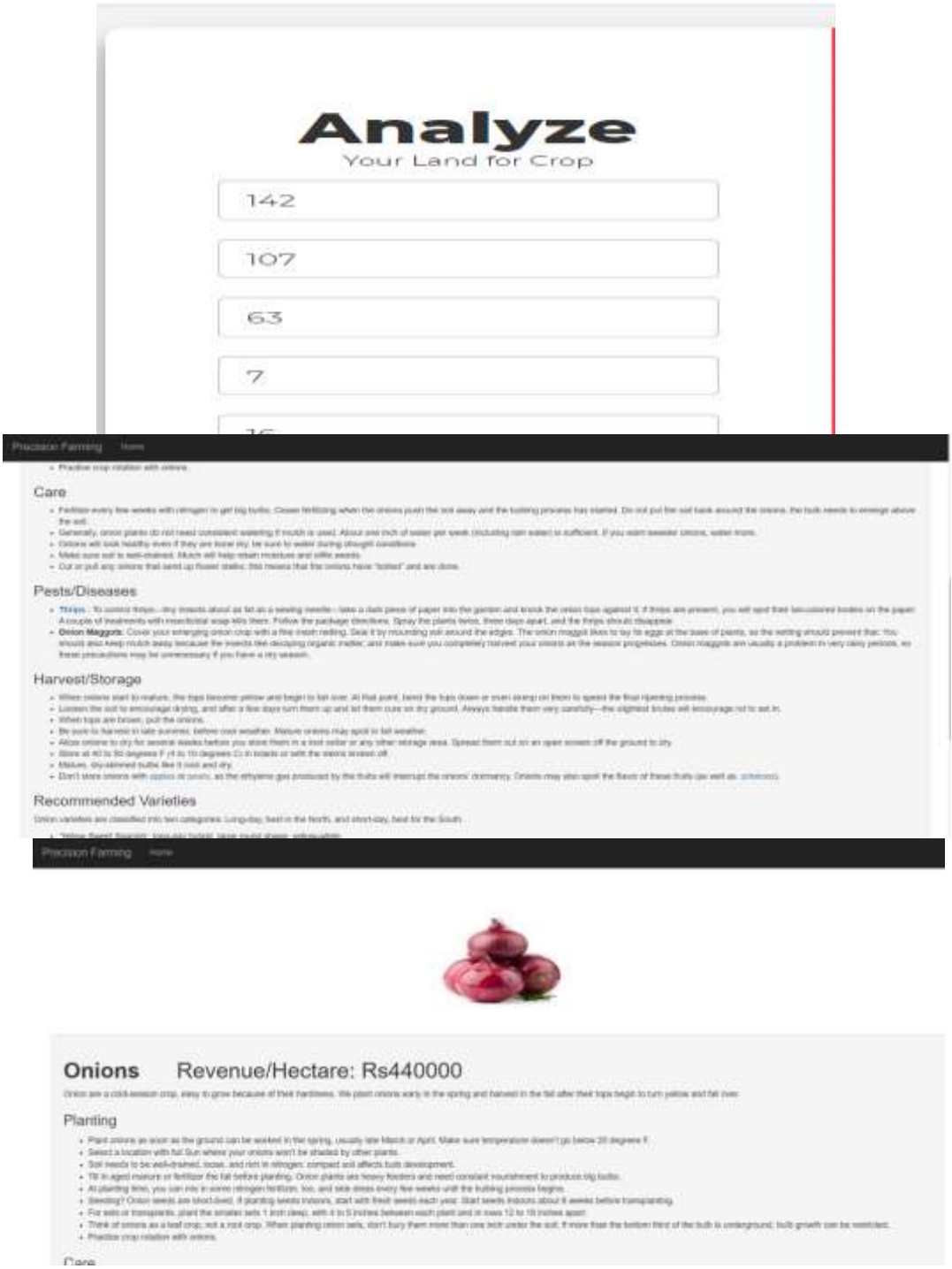

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Fig 5.2: Onion Crop

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Tomato Cultivation Guide Revenue/Hectare: Rs426000

Climatic Requirements

Tomato is a warm season crop, it requires warm and cool climate. The plants cannot withstand frost and high humidity. Also light intensity affects pigmentation, fruit colour, fruit set. The plant is highly affected by adverse climatic conditions. It requires different climatic range for seed germination, seedling growth, flower and fruit set, and fruit quality. Temperature below 10°C and above 38°C adversely affects plant tissues thereby slow down physiological activities. It thrives well in temperature 10°C to 30°C with optimum range of temperature is 21-24°C. The mean temperature below 16°C and above 27°C are not desirable. The plant doesn't withstand frost, it requires low to medium rainfall, and does well under average monthly temperature of 21 to 23°C. Avoid water stress and long dry period as it causes cracking of fruits. Bright sunshine at the time of fruit set helps to develop dark red coloured fruits.

Temperature Requirement

Sr. No.	Stages	Temperature (°C)		
		Minimum	Suitable	Maximum
1	Seed germination	11	16-29	34

Choice of seeds

After seed production, diseased, broken seeds are discarded. The seeds for sowing should be free from inert matter. Early germinating, bold, uniform in shape and size, seeds are selected for sowing. Hybrid seeds from F1 generation are advantageous for sowing as it gives early and high yield uniform fruits, resistant to adverse environmental conditions.

a) Seed and sowing

Tomato is generally cultivated by transplanting seedlings on ridges and furrows. At the time of transplanting seedlings are harden by exposing to open weather or by withholding irrigation. A seed rate of 400 to 500g/ha is required.

Seeds are treated with Thiram @ 3g/kg of seed to protect from seed born diseases. Seed treatment with B. naphthoxyacetic acid (BNOA) at 20 and 50 ppm, gibberlic acid (GA3) at 5-20 ppm and chlorophenoxy acetic at 10 and 20 ppm was found to improve the growth and yield of tomato.

Seeds are sown in June July for autumn winter crop and for spring summer crop seeds are sown in November. In the hills seed is sown in March April. The spacing recommended for the autumn winter crop is 75 x 60cm and for spring summer crop 75 x 45cm.

Nursery Preparation and Care

The raise seedbed should be 60cm wide, 5-6cm long and 20-25cm high. Clods and stubbles should be removed from the seedbed. Add sieved FYM and fine sand on the seedbed. Bring them to fine tilth. Drench the bed with Fytolon/Dithane M-45 @ 2-2.5 g/lit of water. Draw the lines 10 to 15cm apart throughout the length of the seedbed. Sow the seeds thinly spaced in lines, press gently, cover with fine sand and then cover the bed with straw. Irrigate with rose can. Irrigate the seedbed twice a day till the seeds germinate. Remove the straw after the seeds germinate. Apply a little Thimet at 4-5 leaf stage. Spray the seedlings with Metasystox/Thiodan @ 2-2.5 ml/lit water and Dithane M-45 @ 2-2.5 g/lit water.

Fertilizers

As the fruit production and quality depends upon nutrient availability and fertilizer application so balance fertilizer are applied as per requirement. The nitrogen in adequate quantity increases fruit quality, fruit size, color and taste. It also helps in increasing desirable acidic flavor. Adequate amount of potassium is also required for growth, yield and quality. Mono Ammonium Phosphate (MAP) may be used as a starter fertilizer to supply adequate phosphorus during germination and seedling stages. Calcium availability is also very important to control soil pH and nutrient availability. Sandy soils will require a higher rate of fertilizer, and more frequent applications of these fertilizers due to increased leaching of essential nutrients. The seedlings are sprayed with starter solution of micronutrient. Before planting farm yard manure @ 50 ton per hectares should be incorporated. Normally tomato crop requires 120kg Nitrogen (N), 50kg Phosphorus (P_2O_5), and 50kg Potash (K_2O). Nitrogen should be given in split doses. Half nitrogen and full P_2O_5 is given at the time of transplanting and remaining nitrogen is given after 30 days and 60 days of transplanting.

Soil and tissue analyses should be taken throughout the growing and production season to insure essential nutrients are in their proper amounts and ratios. Tissue analysis of a nutritionally sufficient plant will show the following nutrient status:

	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium	Sulphur
%	4.0-6.6	0.30-0.60	3.0-4.5	1.25-3.2	0.4-0.65	0.65-1.4
	ppm	Manganese	Iron	Boron	Copper	Zinc
		30-400	35-300	20-60	5-15	35-90

In the present situation it has been realized that the use of inorganic fertilizers should be integrated with renewable and environmental friendly organic fertilizers, crop residues and green manures.

Fig 5.2.1: Tomato crop

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Spices & Condiments: Garlic Revenue/Hectare: Rs98000

Introduction

Garlic, a native of Southern Europe is one of the important bulb crops grown and used as a spice or condiment throughout India. Gujarat followed by Orissa are the largest producing states. It possesses a high nutritive value, its preparations are administered as a cure against stomach disease, sore eyes and ear ache. It is commonly used in the preparation of various dishes. Allicin, the principle aerostic dysentry and is also having many other medicinal properties.

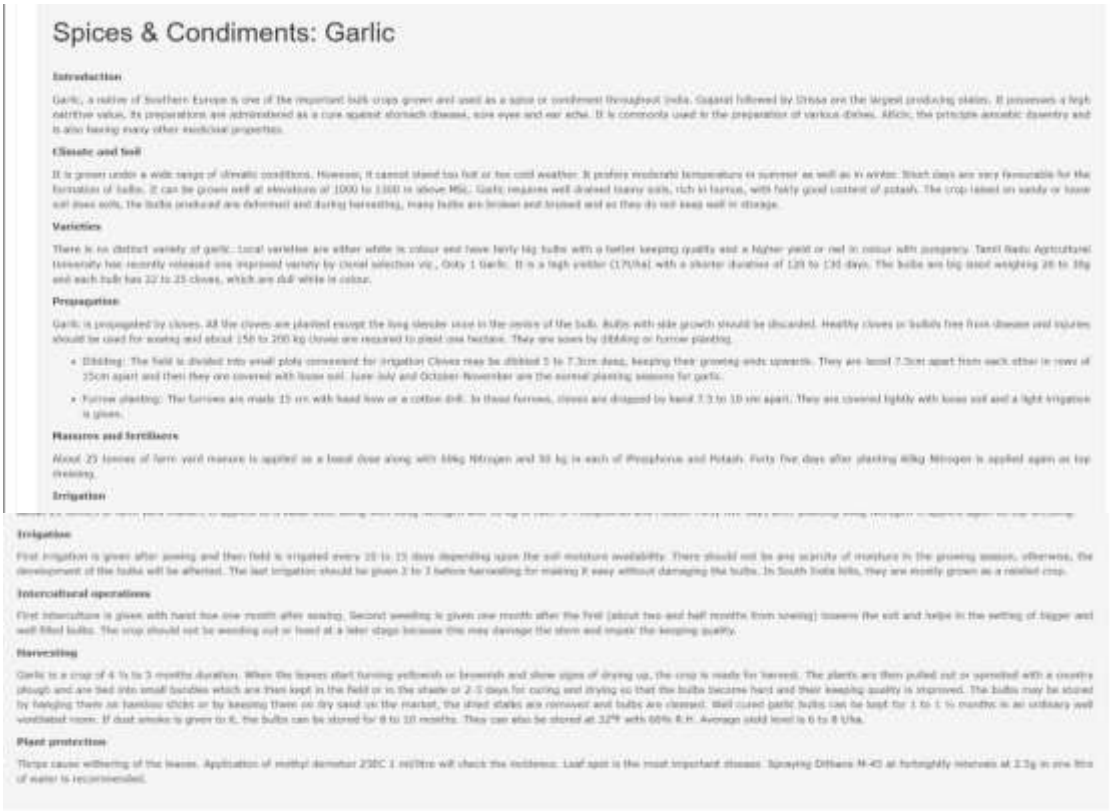
Climate and Soil

It is grown under a wide range of climatic conditions. However, it cannot stand too hot or too cold weather. It prefers moderate temperature in summer as well as in winter. Short days are very favourable for the formation of bulbs. It can be grown well at elevations of 1000 to 1300 m above MSL. Garlic requires well drained loamy soils, rich in humus, with fairly good content of potash. The crop raised on sandy or loose soil does soils, the bulbs produced are deformed and during harvesting, many bulbs are broken and bruised and so they do not keep well in storage.

Varieties

There is no distinct variety of garlic. Local varieties are either white in colour and have fairly big bulbs with a better keeping quality and a higher yield or red in colour with pungency. Tamil Nadu Agricultural University has recently released one improved variety by clonal selection viz., Ooty 1 Garlic. It is a high yielder (17t/ha) with a shorter duration of 120 to 130 days. The bulbs are big sized weighing 20 to 30g and each bulb has 22 to 25 cloves, which are dull white in colour.

Propagation



Spices & Condiments: Garlic

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Propagation

Garlic is propagated by cloves. All the cloves are planted except the long slender clove in the centre of the bulb. Bulbs with side growth should be discarded. Healthy cloves or bulbils free from disease and injuries should be used for sowing and about 150 to 200 kg cloves are required to plant one hectare. They are sown by dibbling or furrow planting.

- Dibbling: The field is divided into small plots convenient for irrigation Cloves may be dibbled 5 to 7.5cm deep, keeping their growing ends upwards. They are kept 7.5cm apart from each other in rows of 15cm apart and then they are covered with loose soil. June-July and October-November are the normal planting seasons for garlic.
- Furrow planting: The furrows are made 15 cm with hand hoe or a cotton drill. In these furrows, cloves are dropped by hand 7.5 to 10 cm apart. They are covered lightly with loose soil and a light irrigation is given.

Manures and fertilizers

About 25 tonnes of farm yard manure is applied as a basal dose along with 50kg Nitrogen and 50 kg in each of Phosphorus and Potash. Forty five days after planting 40kg Nitrogen is applied again as top dressing.

Irrigation

Irrigation

First irrigation is given after sowing and then field is irrigated every 10 to 15 days depending upon the soil moisture availability. There should not be any scarcity of moisture in the growing season, otherwise, the development of the bulbs will be affected. The last irrigation should be given 2 to 3 before harvesting for making it easy without damaging the bulbs. In South India hills, they are mostly grown as a rainfed crop.

Intercultural operations

First interculture is given with hand hoe one month after sowing. Second weeding is given one month after the first (about two and half months from sowing) loosens the soil and helps in the setting of bigger and well filled bulbs. The crop should not be weeding out or hoed at a later stage because this may damage the stem and impair the keeping quality.

Harvesting

Garlic is a crop of 4 ½ to 5 months duration. When the leaves start turning yellowish or brownish and show signs of drying up, the crop is ready for harvest. The plants are then pulled out or uprooted with a country plough and are tied into small bundles which are then kept in the field or in the shade or 2-3 days for curing and drying so that the bulbs become hard and their keeping quality is improved. The bulbs may be stored by hanging them on bamboo sticks or by keeping them on dry sand in the market, the dried stalks are removed and bulbs are cleaned. Well cured garlic bulbs can be kept for 1 to 1 ½ months in an ordinary well ventilated room. If dust smoke is given to it, the bulbs can be stored for 6 to 10 months. They can also be stored at 32°F with 65% R.H. Average yield level is 6 to 8 t/ha.

Plant protection

Thrips cause withering of the leaves. Application of methyl demeton 25EC 1 ml/litre will check the incidence. Leaf spot is the most important disease. Spraying Ditheane M-45 at fortnightly intervals at 2.5g in one litre of water is recommended.

Fig 5.2.3: Garlic crop

CHAPTER

CONCLUSION

- This project presents a Machine learning framework for the task of crop yield prediction, based on inexpensive remote sensing data.
- It allows for real time forecasting throughout the year and is applicable world-wide, especially for developing countries where field surveys are hard to conduct.
- We are the first to use modern representation learning ideas for crop yield prediction, and successfully learn much more effective features from raw data compared with the hand-crafted features that are typically used.
- We propose a dimensionality reduction approach based on KNN Classifier algorithm for model provides us with the state-of-the-art prediction accuracy and will have great impact in sustainable agriculture and food security.

CHAPTER

FUTURE SCOPE

It is not possible to develop a system that makes all the requirements of the user. User requirements keep changing as the system is being used. Some of the future enhancements that can be done to this system are:

- As the technology emerges, it is possible to upgrade the system and can be adaptable to desired environment.
- Based on the future security issues, security can be improved using emerging technologies like sin-glesign-on.

CHAPTER

REFERENCES

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