

SAVITRIBAI PHULE PUNE UNIVERSITY

A Project Report on

**Machine Learning Techniques For Crop
Yield Prediction**

SUBMITTED TOWARDS THE

PARTIAL FULFILLMENT OF THE REQUIREMENTS OF

BACHELOR OF ENGINEERING (Computer Engineering)

By

Prajwal Sable Exam No:COMPBEA1102

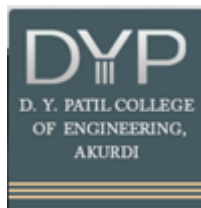
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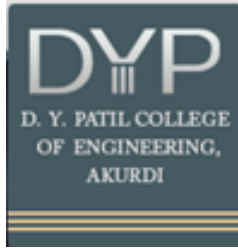
Under The Guidance of

Mrs.Vaishali Kolhe



Department of Computer Engineering

**D. Y. Patil College of Engineering,
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**D. Y. Patil College of Engineering, Akurdi.
Department of Computer Engineering**

CERTIFICATE

This is to certify that the Project Entitled

**Machine Learning Techniques For Crop
Yield Prediction**

Submitted by

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is a bonafide work carried out by Students under the supervision of Mrs.Vaishali Kolhe and it is submitted towards the partial fulfillment of the requirement of Bachelor of Engineering (Computer Engineering).

Mrs.Vaishali Kolhe

Internal Guide

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Signature of Internal Examiner

Signature of External Examiner

PROJECT APPROVAL SHEET

A Project Title

Machine Learning Techniques For Crop

Yield Prediction

is successfully completed by

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Ashish Dongare Exam No:COMPBEA1103

Atharva Mohite Exam No:COMPBEA1104

Mandar Kulkarni Exam No:COMPBEA1109

at

DEPARTMENT OF COMPUTER ENGINEERING

(D. Y. Patil College of Engineering, Akurdi.)

SAVITRIBAI PHULE PUNE UNIVERSITY,PUNE

ACADEMIC YEAR 2022-2023

Mrs.Vaishali Kolhe

Internal Guide

Dept. of Computer Engg.

Dr.M.A.Potey

H.O.D

Dept. of Computer Engg.

ABSTRACT

As agriculture being the primary occupation of India, large part of population invests in agriculture activities. But the figures show that despite being into agriculture activities all these years, there is not satisfactory growth in agriculture sector. The major reason behind this is poor productivity due to lesser yield of crops. The lack of knowledge, resources and poor policies deplete the crop yields, subsequently leading farmers to take harsh decisions. There has been research on crop patterns, soils, and climatic conditions to boost yield of crops, but still results are not up to mark. The reason for this is less research or faults in it, but the research work is not being utilized by farmer as there is not platform or medium through which farmers can use this knowledge. So the project aims to develop platform which will be providing interface where an farmer as well market persons can get descriptive as well as predictive analysis regarding crop patterns, that will help to increase crop yield as well farmer can get better idea regarding crop patterns and recent market requirements

ACKNOWLEDGEMENT

It gives us great pleasure in presenting the preliminary project report on 'Machine Learning Techniques For Crop Yield Prediction'.

I express sincere and profound thanks to Mrs.Vaishali Kolhe, seminar Guide, and HOD Prof. Dr.M.A.Potey, who was ready to help with the most diverse problems that I have encountered along the way. We express sincere thanks to all staff and colleagues who have helped directly or indirectly in completing this project successfully.

Prajwal Sable

Ashish Dongare

Atharva Mohite

Mandar Kulkarni

(B.E. Computer Engg.)

Contents

Title Page	i
Certificate	ii
Project Approval Sheet	iii
Abstract	iv
Acknowledgement	v
1 Synopsis	1
1.1 Project Title	1
1.2 Project Option	1
1.3 Internal Guide	1
1.4 Sponsorship and External Guide	1
1.5 Technical Keywords	1
1.6 Problem Statement	2
1.7 Abstract	2
1.8 Goals and Objectives	2
1.9 Relevant mathematics associated with the Project . .	3
1.10 Conferences/Journals where papers can be published	3
1.11 Review of Conference/Journal Supporting Project Idea	4
1.12 Plan of Project Execution	9

2	Technical Keywords	10
2.1	Area of Project	10
2.2	Technical Keywords	10
3	Introduction	11
3.1	Project Idea	11
3.2	Motivation of the Project	11
3.3	Literature Survey	12
4	Problem Definition and Scope	17
4.1	Problem Statement	17
4.1.1	Goals and Objectives	17
4.1.2	Statement of Scope	17
4.2	Major Constraints	17
4.3	Methodologies of Problem Solving and Efficiency Issues	18
4.3.1	Classification techniques	18
4.4	Outcome	19
4.5	Applications	19
4.6	Hardware Resources Required	19
4.7	Software Resources Required	19
5	Project Plan	20

5.1	Project Estimates	20
5.1.1	Reconciled Estimates	20
5.1.2	Project Resources	20
5.2	Risk Management w.r.t. NP-Hard Analysis	20
5.2.1	Risk Identification	21
5.3	Project Schedule	21
5.3.1	Project Task Set	21
5.3.2	Task Network	22
5.3.3	Timeline Chart	22
5.4	Team Organization	22
5.4.1	Team Structure	23
5.4.2	Management Reporting and Communication	23

6 Software Requirement Specification 24

6.1	Introduction	24
6.1.1	Purpose and Scope of Document	24
6.1.2	Overview of Responsibilities of Developer	24
6.2	Usage Scenario	24
6.2.1	User Profiles	24
6.2.2	Use Cases	25
6.2.3	Use Case View	25

6.3	Data Model and Description	26
6.3.1	Data Description	26
6.3.2	Data Objects and Relationships	26
6.4	Functional Model and Description	27
6.4.1	Data Flow Diagram	28
6.4.2	Activity Diagram	29
6.4.3	Non Functional Requirements:	29
6.4.4	State Diagram	30
6.4.5	Design Constraints	31
6.4.6	Software Interface Description	31

7 Detailed Design Document Using Appendix 32

7.1	Introduction	32
7.2	Architectural Design	32
7.3	Data Design (Using Appendices A and B)	33
7.3.1	Internal Software Data Structures	33
7.3.2	Global Data Structure	33
7.3.3	Database Description	33
7.4	Component Design	34
7.4.1	Class Diagram	34
7.4.2	Interaction Diagram	34

7.4.3	Algorithms	35
8	Project Implementation	36
8.1	Introduction	36
8.2	Tools and Technologies Used	36
8.3	Methodologies/Algorithm Details	36
8.3.1	SVM	36
8.3.2	random Forest	37
8.4	Verification and Validation for Acceptance	37
9	Software Testing	38
9.1	Test Cases	38
10	Conclusion and Future Scope	39
10.1	conclusion	39
11	Bibliography	40
	Appendix References	42
	Appendix Laboratory assignments on Project Analysis of Algorithmic Design	44
	Appendix Lab assign on Project Quality and Reliability Testingof Project Design	45
	Appendix Project Planner	46

Appendix Reviewers Comments of Paper Submitted	47
Appendix Plagiarism Report	48
Appendix Information of Project Group Members	49

List of Figures

Fig 1. Sample	2
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List of Tables

1.	8
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List of Abbreviations

1. ML : Machine Learning
2. SVM : Support Vector Machine
3. KNN : K-Nearest Neighbour

1 Synopsis

1.1 Project Title

Machine Learning Techniques For Crop Yield Prediction

1.2 Project Option

Internal Project

1.3 Internal Guide

Mrs. Vaishali Kolhe

1.4 Sponsorship and External Guide

1.5 Technical Keywords

Machine Learning

Support Vector Machine

Feature extraction

Random Forest Algorithm

1.6 Problem Statement

To predict the crop that will give better yield in field based on features like location, climate and physiography using Machine Learning.

1.7 Abstract

As agriculture being the primary occupation of India, large part of population invests in agriculture activities. But the figures show that despite being into agriculture activities all these years, there is not satisfactory growth in agriculture sector.

The lack of knowledge, resources and poor policies deplete the crop yields, subsequently leading farmers to take harsh decisions. There has been research on crop patterns, soils, and climatic conditions to boost yield of crops, but still results are not up to mark.

So the project aims to develop platform which will be providing interface where an farmer as well market persons can get descriptive as well as predictive analysis regarding crop patterns, that will help to increase crop yield as well farmer can get better idea regarding crop patterns and recent market requirements

1.8 Goals and Objectives

- Study features of crops dataset and thereby predicting better crop to be yield
- To implement ML algorithms
- Create User Interface

1.9 Relevant mathematics associated with the Project

System Description:

- Input : User input (location,soil type ,climate)
- Output : Prediction of crop that will give best yield /profit.

1.10 Conferences/Journals where papers can be published

- IEEE/ACM - International Conference on Machine Learning and Applications
- Conferences/Workshops in IITs
- Central Universities or SPPU
- Springer/ACM Conference/IEEE International Conference on AI for Good

1.11 Review of Conference/Journal Supporting Project Idea

Sr. No.	Title and Authors	Conference / Journal Name and Publication Year	Topic Reviewed/ Algorithms or methodology used	Advantages and disadvantages
1	Crop Prediction using Machine Learning. Authors: Kalimuthu, P. Vaishnavi, M. Kishore	IEEE Xplore (2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT)), 2020	Detailed presentation of machine learning algorithm which suggest crop based on input parameters like soil, temperature, etc.	Advantage: The proper writing, elaboration and applications of concepts along with results.
2	Prediction of Crop Yield using Regression Analysis Authors: Renuka, Sujata Terdal	Indian Journal of Science and Technology, Vol 9(38), October 2016	deeply elaborated and explained the approach of Regression	clearer picture of regression algorithm for classification.

Sr. No.	Title and Authors	Conference / Journal Name and Publication Year	Topic Reviewed/ Algorithms or methodology used	Advantages and disadvantages
3	Evaluation of Machine Learning Algorithms for Crop Authors: Kshira Sagar Sahoo, Bata Krishna Tripathy, Bata Krishna Tripathy, Somula Ramasubbareddy	IJEAT, Volume-8 Issue-6, August, 2019	Authors have proposed support vector machine, decision tree and KNN methodology	Advantage: Simple and clear explanation
4	Impact of Machine Learning Techniques in Precision Agriculture Authors: Rahul Katarya, Ashutosh Raturi, Abhinav Mehndiratta, Abhinav Thapper	3rd International Conference on Emerging Technologies in Computer Engineering IEEE Xplore, 14 may 2020	Explained different applications of machine learning for agriculture.	Advantage: Provides brief description about ml techniques that can help in agriculture sector.

Sr. No.	Title and Authors	Conference / Journal Name and Publication Year	Topic Reviewed/ Algorithms or methodology used	Advantages and disadvantages
5	Machine Learning in Agriculture: A Comprehensive Updated Review	Sensors 2021, Published: 28 May 2021	presents a role of machine learning in agriculture optimization.	Advantages: Different approaches explained
6	A Study on Crop Yield Forecasting Using Classification Techniques Authors: P. Isakki, R. Sujatha	2016 International Conference on Computing Technologies and Intelligent Data Engineering (ICCTIDE'16)	In this paper, we have demonstrated to estimate the crop yield, choose the most excellent crop, thereby improves the value and gain of the farming area using data mining techniques	Advantage: Provides brief description about ml techniques

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7	Agriculture Decision Support System using Data Mining Authors: Rakesh Shirsath, Neha Khadke, Divya More, Pooja Patil; Harshali Patil	2017 International Conference on Intelligent Computing and Control (I2C2) IEEE Xplore: 22 March 2018	Paper presents the Process of building prediction model for crop yield briefly.	Advantage: Simple and clear explanation
8	Applications of Machine Learning Techniques in Agricultural Crop Production: A Review Paper Authors: Subhadra Mishra, Debahuti Mishra ¹ and Gour Hari Santra	Indian Journal of Science and Technology, Vol 9(38), Oct 2016 IEEE Xplore ,14 may 2020	: research studies on the relevance of machine learning techniques in the domain of agricultural crop production.	This paper describes how improving agriculture yields by previous agriculture information

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9	Performance Analysis of Supervised Learning Algorithms based on Classification Approach Authors: Fazeel Ahmed Khan, Adamu Abubakar Ibrahim	2019 6th IEEE IC-ETAS	Explained different ML algorithms, methodology and different performance evaluation techniques.	Advantage: Evaluation techniques can be utilized to apply the given algorithm in different required use-cases
10	Performance Evaluation of Best Feature Subsets for Crop Yield Prediction Using Machine Learning Algorithms Authors: Bhargavi R, Maya Gopal P. S.	Publishes online: 05 Apr 2019	T evaluates the most needed features for accurate crop yield production.	Advantage: brief description

1.12 Plan of Project Execution

Topic	Module Head	current status	plan of completion
Requirement Analysis	Ashish	Done	October
Data Collection/Analysis	Ashish , Mandar	Started	November
Model Generation	Atharva	Started	December
Testing	Prajwal,Ashish		January
UI Design	Prajwal,Mandar	In operation	February
Documentation	Prajwal	In operation	March

2 Technical Keywords

2.1 Area of Project

Data Analysis, Crop Study, Machine Learning

2.2 Technical Keywords

- Machine Learning
- Support Vector Machine
- Feature extraction
- Random Forest Algorithm

3 Introduction

3.1 Project Idea

The farmer face the issue of lesser crop yield, due to improper crop pattern, less resources and many of such factors. The goal here is to solve this problem, by creating platform where user (in this case farmer) can sign in ,get prediction of crop that will give better production outcome. department.

3.2 Motivation of the Project

As in India, farming is one of the primary occupation of most of population still we lack in the profits/economy when it comes to farming. The lack of knowledge, resources and poor policies deplete the crop yields ,subsequently leading farmers to take harsh decisions. Also, almost everyone from team comes from farmers back-ground and have faced/seen similar issues. Hence, it seemed the perfect opportunity as software engineers to deliver a product which can help farmers to boost their crop yield ,providing them right market, acquainting with better policies /schemes thereby help them doing agriculture is more resourceful way.

3.3 Literature Survey

Sr. No.	Title and Authors	Conference / Journal Name and Publication Year	Topic Reviewed/ Algorithms or methodology used	Advantages and disadvantages
1	Crop Prediction using Machine Learning. Authors: Kalimuthu, P. Vaishnavi, M. Kishore	IEEE Xplore (2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT)), 2020	Detailed presentation of machine learning algorithm which suggest crop based on input parameters like soil, temperature, etc.	Advantage: The proper writing, elaboration and applications of concepts along with results.
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4 Problem Definition and Scope

4.1 Problem Statement

To predict the crop that will give better yield in field based on features like location, climate and physiography using Machine Learning.

4.1.1 Goals and Objectives

- Study features of crops dataset and thereby predicting better crop to be yield
- To implement ML algorithms
- Create User Interface .

4.1.2 Statement of Scope

Our project aims to predict the crop that will give better yield results to farmers by means of

1. Data Analysis of inputs like soil, climate and location dataset.
2. Machine learning classification methods

The user's input will include parameters like location, soil, etc and output would be in form of number of crop/crops that will give better production.

4.2 Major Constraints

Real time data of crop production and climatic conditions

4.3 Methodologies of Problem Solving and Efficiency Issues

4.3.1 Classification techniques

Support Vector Machines are a maximal margin hyperplane classification method that relies on results from statistical learning theory to guarantee high generalization performance.

n

Random Forest ALgorithm 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 overfitting.

4.4 Outcome

A User (Farmer) can get prediction or recommendation for crops to be cultivated based upon his input parameters .

4.5 Applications

- 1.Famer can get pre-idea of crop pattern which will help to increase the production.
2. To create a centralized platform /communication medium for farmer where results study can be shared .
- 3.Motivate Further studies and improvement in filed of ML with agriculture.

4.6 Hardware Resources Required

Sr .No	Parameter	Minimum Requirement	Justification
1	CPU speed	2 GHz	Multi Threading
2	RAM	2 GB	High Processing Speed

4.7 Software Resources Required

1. Operating System: Windows 10
2. IDE: Visual Studio Code, Jupyter Notebook, Notepad++
3. Programming Language: Python, Javascript

5 Project Plan

5.1 Project Estimates

5.1.1 Reconciled Estimates

Cost Estimate: Nil

Time Estimates: By March 2023, the GUI will be ready to use

5.1.2 Project Resources

People

1. Software Developer (Python)
2. Operating Systems Engineer
3. User Interface (UI/UX) Engineer

Minimum Hardware Requirements

1. RAM 4 GB
2. Storage 20 GB

Software Requirements

1. Visual Studio Code

5.2 Risk Management w.r.t. NP-Hard Analysis

Project Risk Analysis and Management is a process that enables the analysis and management of the risks associated with a project. Properly undertaken it will increase the likelihood of successful completion of a project to cost, time, and performance objectives.

Project Risk Analysis and Management is a process designed to remove or reduce the risks which threaten the achievement of project objectives. The next section of this Guide describes the benefits which Project Risk Analysis and Management can bring to a project and also the wider benefits to the organization and its customers.

It should be regarded as an integral part of project or business management and not just as a set of tools or techniques

5.2.1 Risk Identification

For risks identification, a review of the scope document, requirements specifications, and schedule is done as follows:

Sr. No.	Questions	Answers
1	Are end-users enthusiastically committed to the project and the system/product to be built	Yes
2	Are requirements fully understood by the software engineering team and its customers	Yes
3	Do end-users have realistic expectations	Yes
4	Does the software engineering team have the right mix of skills	Yes
5	Are project requirements stable	Yes
6	Is the number of people on the project team adequate to do the job	Yes
7	Do all customer/user constituencies agree on the importance of the project and on the requirements for the system/product to be built	Yes

5.3 Project Schedule

5.3.1 Project Task Set

Major Tasks in the Project stages are:

1. Crop Data Collection
2. Crop Data Analysis
3. Model Development
4. Testing
5. User Interface Design

888
111
222

Topic	current status	plan of completion
Requirement Analysis	Done	October
Data Collection/Analysis	Started	November
Model Generation	Started	December
Testing		January
UI Design	In operation	February
Documentation	In operation	March

Github.com is used for reporting and keeping all work in sync with all members of the group

5.4.1 Team Structure

Prajwal Sable : Responsible for Crop dataset Analysis and Feature study

Mandar Kulkarni:Responsible for developing the User Interface

Atharva Mohite:Responsible for Crop Prediction Module

Ashish Dongare: Responsible for Code Maintenance, Documentation and Resource Management

5.4.2 Management Reporting and Communication

Github is used for reporting and keeping all work in sync with all members of the group

6 Software Requirement Specification

6.1 Introduction

6.1.1 Purpose and Scope of Document

This document has been created to give a brief overview of the project “Machine Learning Techniques For Crop Yield Prediction”. It covers all the application-related information including specification, purpose, uses, etc.

This project is made to help farmers to decide the crop to be cultivated in the farm that will give better yield production

6.1.2 Overview of Responsibilities of Developer

The developers have extensively worked on Crop data Analysis followed by Crop Yield Prediction . These two modules are then merged and bound together with the help of a user-friendly interface.

6.2 Usage Scenario

6.2.1 User Profiles

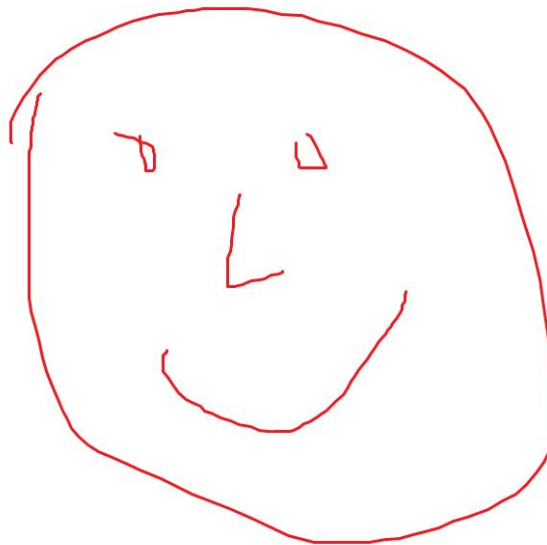
The profiles of all user categories are described here.

User: The user can use this software to get crop recommendation having better yield results

Developer: The developer can add and modify functionalities based on user feedback from time to time to make the software more precise, accurate, and helpful to users.

6.2.2 Use Cases

Sr. No.	Use case	Description	Actor	Assumptions
1	Enter data	input the required parameters of crops	User	Nil
2	Get Re-sults	hit results tab to get crop predictions	User	Nil

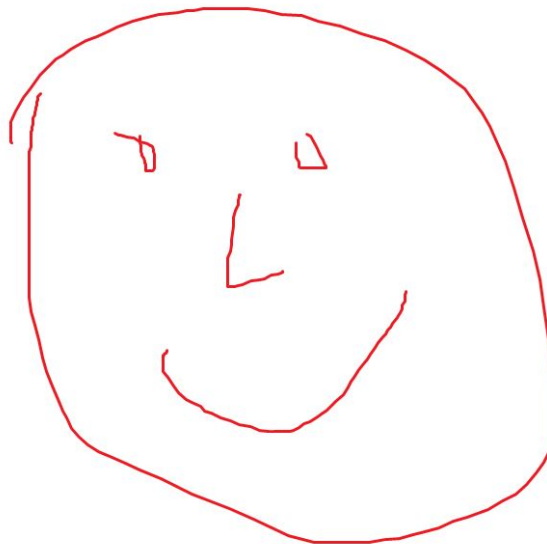
6.2.3 Use Case View

6.3 Data Model and Description

6.3.1 Data Description

Text Data: The data will be textual in form of parameters like soil type, location and climate.

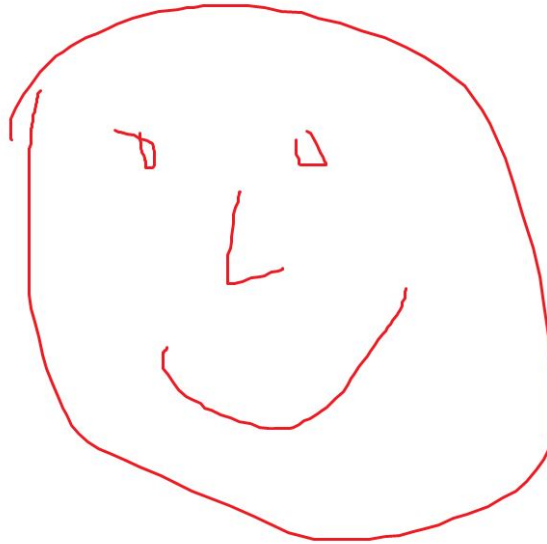
6.3.2 Data Objects and Relationships



The above diagram shows the relation between the data objects i.e. how input is given and how results are obtained

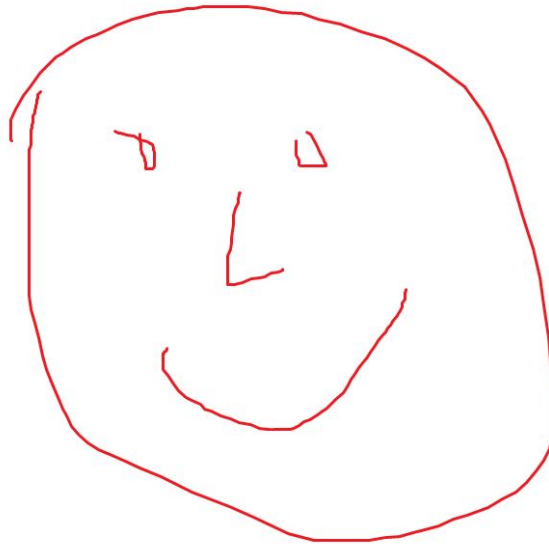
6.4 Functional Model and Description

The class diagram shows the relation between all the functions, modules, data structures and shows the links i.e. extends and aggregation

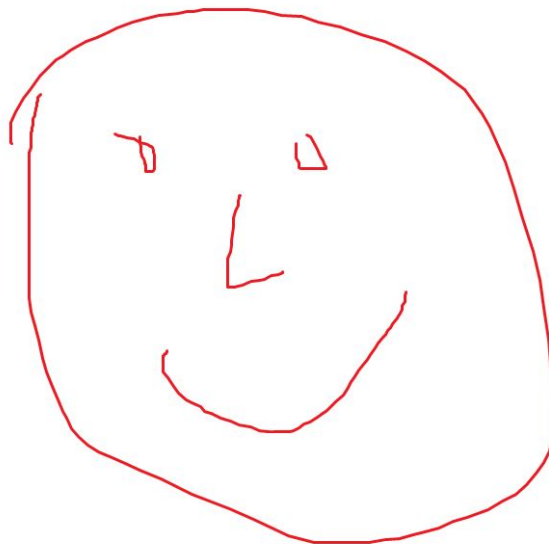


6.4.1 Data Flow Diagram

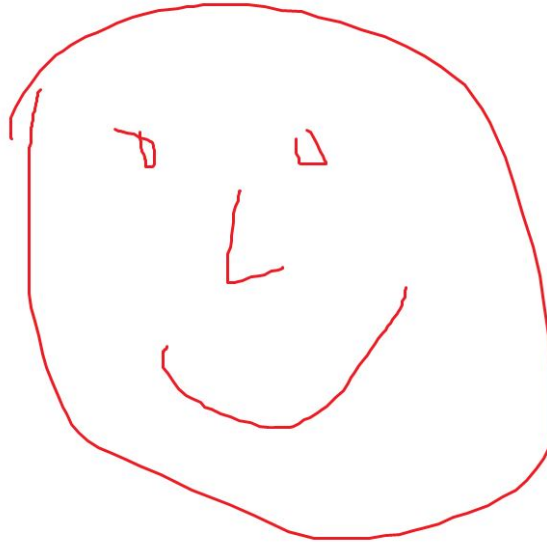
level 0 data flow diagram



level 1 data flow diagram



6.4.2 Activity Diagram



6.4.3 Non Functional Requirements:

Performance Requirements The accuracy of the proposed system is better than the previous data programming paradigms such as SVM Model. The end-user has to just feed the data once the system and the entire further process are automated. No manual intervention after training the data is demanded

Software Quality Attributes

- 1. Correctness:** The correctness of the system depends on the accuracy of the model. If the dataset is accurate according to the personality dataset then the system has achieved its correctness to the maximum level.
- 2. Reliability:** The system is reliable because every module has its reconstruction and recording possible multiple times.
- 3. Robustness:** The system is robust enough to perform preprocessing and manipulations over large datasets. Compatible with different operating systems.

4. Maintainability: It depends on the following factors:

- a) Readability: The dataset is readable and preprocessing is being done to reduce the noise in the system.
- b) Extensibility: The dataset can be of variable size from Kilobytes to Megabytes. The system is capable of performing computations on small, medium, and large datasets.
- c) Testability: Generation of the correct labels leads to the development of the correct test cases and test plans for future testing

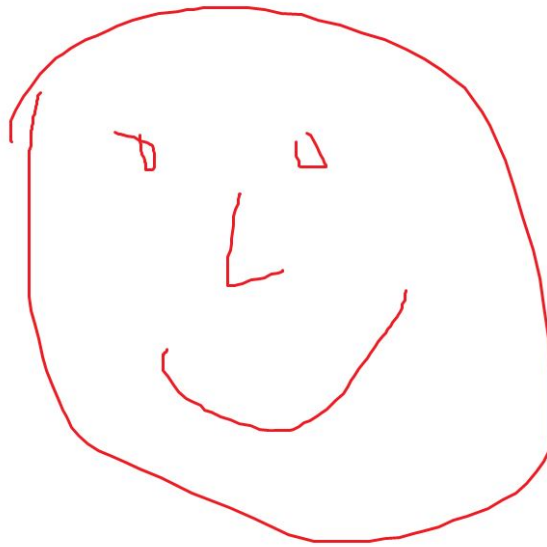
5. Efficiency: Higher the GPU, CPU, and RAM processing higher is the efficiency. The efficiency also depends on the quality of the input data.

6. Availability: The input dataset must be available in a segregated manner so that it is easy to manipulate.

7. Usability: The system is easy to handle, it also navigates expectedly with minimum delays. In such a case, the system reacts accordingly and transverses quickly between its states

6.4.4 State Diagram

A state diagram is the graphical representation of a state machine and one of the 14 UML diagram types for software and systems. State diagrams show a behavioral model consisting of states, state transitions, and actions. State diagrams depict the permitted states and transitions as well as the events that affect these transitions.



6.4.5 Design Constraints

- 1. Language:** Python
- 2. Technologies:** Machine Learning
- 3. Database:** CSV and Hard Disk Drive
- 4. Estimated Time of Completion:** March 2023
- 5. Testing:** Manual

6.4.6 Software Interface Description

The user will be required to open the application and enter the required crop data of him/her. Then data can be analyzed using various machine learning techniques.

The result of the analysis will be shown to the user in both textual and graphical form, i.e. the crops will give better yield production.

7.1 Introduction

[illegible]

A simple red line drawing of a smiling face. The face is enclosed in a large, irregular, hand-drawn red outline. Inside, there are two small, simple eyes represented by short horizontal lines. The mouth is a wide, curved line, giving the face a happy expression. The drawing is minimalist and appears to be a quick sketch.

7.3 Data Design (Using Appendices A and B)

7.3.1 Internal Software Data Structures

Crop data: input parameters

7.3.2 Global Data Structure

Dataset : source

7.3.3 Database Description

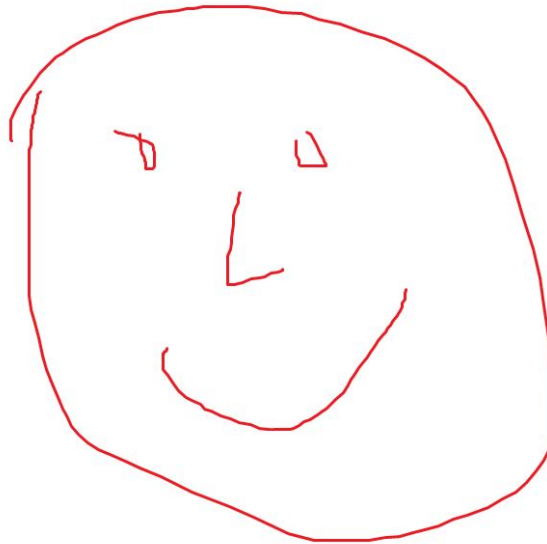
Crop prediction Model File- For storing structured data and relations

Train and Test Dataset File- For Model Generation

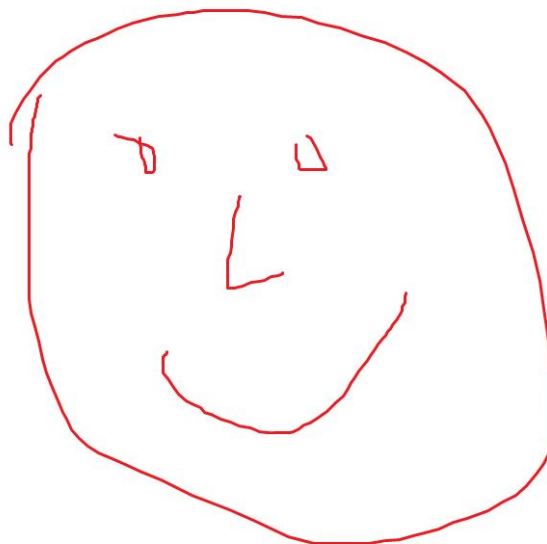
UI/UX File- Using HTML ,CSS,Javascript,Flask

7.4 Component Design

7.4.1 Class Diagram



7.4.2 Interaction Diagram



7.4.3 Algorithms

Support Vector Machines are a maximal margin hyperplane classification method that relies on results from statistical learning theory to guarantee high generalization performance.

S

Random Forest ALgorithm 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 overfitting.

8 Project Implementation

8.1 Introduction

The farmer face the issue of lesser crop yield, due to improper crop pattern, less resources and many of such factors. The goal here is to solve this problem, by creating platform where user (in this case farmer) can sign in ,get proper analysis reports for his land/crop .Also, along with that platform focuses on developing common communication medium of farmers,investors,retailers market and government, which will centralize the agriculture department

8.2 Tools and Technologies Used

Tools:

1. Visual Studio Code
2. Jupyter Notebook

Technologies:

1. Machine Learning
2. Flask API

8.3 Methodologies/Algorithm Details

8.3.1 SVM

Support Vector Machines are a maximal margin hyperplane classification method that relies on results from statistical learning theory to guarantee high generalization performance.

8.3.2 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 overfitting.

8.4 Verification and Validation for Acceptance

9 Software Testing

9.1 Test Cases

Test Case 1: Application starting after entering url.

Test Case 2: Input entries validation.

Test Case 3: Fetching the results using result tab .

Test Case 4: Show textual and graphical result.

Test Case 6: Application closing on clicking close tab.

10 Conclusion and Future Scope

10.1 conclusion

In this project, we have successfully Crop yield Prediction and Analysis

1. Real time Prediction
2. Time Series Analysis and Market Comparision UI.

11 Bibliography

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Laboratory assignments on Project Analysis of Algorithmic Design

Laboratory assign. on Project Quality and Reliability Testing of Project Design

Project Planner

Reviewers Comments of Paper Submitted

Appendix Plagiarism Report

Information of Project Group Members