A PROJECT REPORT

ON

"Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability"

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY , PUNE IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE

BACHELOR OF ENGINEERING
(Artificial Intelligence and Data Science)

BY

Vedant Sase	B1912302052
Somesh Chaudhari	B1912302006
Prasad Patil	B1912302045
Sunny Gangurde	B1912302055

Under The Guidance of

Ms. Asmeeta Mali

Dr. D. Y. Patil College of Engineering & Innovation, Varale

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Dr. D. Y. PATIL COLLEGE OF ENGINEERING & INNOVATION

VARALE, TALEGAON, PUNE 410507

SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE
2024 - 25

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Dr. D. Y. PATIL COLLEGE OF ENGINEERING & INNOVATION

VARALE, TALEGAON, PUNE 410507

CERTIFICATE

This is to certify that the Project Entitled

“Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability”

Submitted by

Vedant Sase	B1912302052
Somesh Chaudhari	B1912302006
Prasad Patil	B1912302045
Sunny Gangurde	B1912302055

is a bonafide work carried out by them under the supervision of Mrs. Asmeeta Mali and it is approved for the partial fulfillment of the requirement of Savtribai Phule Pune university, Pune for the award of the degree of Bachelor of Engineering (AI-DS).

Mrs. Asmeeta Mali
Guide
Dept. of AI-DS Engg.

Dr. Dipannita Mondal
H.O.D
Dept. of AI-DS Engg.

Dr. Suresh Mali
Principal
DYPCOEI, Varale

Signature of Internal Examiner

Signature of External Examiner

PROJECT APPROVAL SHEET

A Project Report Titled as

"Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability"

Is verified for its originality in documentation, problem statement, proposed work and implementation successfully completed by

Vedant Sase	B1912302052
Somesh Chaudhari	B1912302006
Prasad Patil	B1912302045
Sunny Gangurde	B1912302055

at

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Dr. D. Y. Patil College of Engineering & Innovation, Varale, Talegaon, Pune

SAVITRIBAI PHULE PUNE UNIVERSITY,PUNE

ACADEMIC YEAR 2024-2025

Mrs. Asmeeta Mali	Dr. Dipannita Mondal
Guide	**H.O.D**
Dept. of AI-DS Engg.	**Dept. of AI-DS Engg.**

Acknowledgments

I, hereby declare that the dissertation titled ***"Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability"*** submitted here it has been carried out of by me in the Department of Artificial Intellingece and Data Science of Dr. D. Y. Patil College of Engineering and Innovation, Varale, Talegaon, Pune. The work is original and has not been submitted earlier as a whole or in the part for the award of any degree at this or any other Institution/ University.

I also hereby assign to ***"Dr. D. Y. Patil College of Engineering and Innovation"*** all rights under copyright that may exist in and to the above work and many revised or expanded derivatives works based on the work as mentioned. Other work copied from references, manuals, etc are disclaimed.

Vedant Sase, Somesh Chaudhari
Prasad patil, Sunny Gangurde
(BE AI-DS)

Place : Pune
Date :

Abstract

In today's farming, it's important to grow crops well and use methods that are good for the environment to meet the rising need for food worldwide. This paper introduces "Smart-Agri Advisor," a system that helps farmers choose the right crops by analysing real-time data about the environment, soil, and market trends. It looks at factors like Soil contents, temperature, humidity and rainfall, along with market demand, to help farmers make smart decisions. The system also uses IoT sensors to automate watering, manage resources better, and make farming more sustainable. This study looks at how well the Smart-Agri Advisor helps improve farming efficiency and matches farming methods with market needs.

Contents

List of Figures

List of Tables

Chapter 1

SYNOPSIS

1.1 Project Title

Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability.

1.2 Project Option

Internal project

1.3 Internal Guide

Internal Guide : Mrs.Asmeeta Mali

1.4 Sponsorship and External Guide

NO

1.5 Technical Keywords (As per ACM Keywords)

Technical Keywords:

- Agriculture
- Data Analytics

- Machine Learning
- Internet of Things (IoT)

1.6 Problem Statement

Nowadays because of unpredictable weather and market conditions it is difficult for farmers to choose, manage their yields, to solve this problem we are presenting a software which will consider and solve above problems.

1.7 Abstract

In the world's population continuously growing, there is an ever-increas-ing demand for food production. Meeting this demand poses a significant challenge, especially as environmental sustainability becomes more critical. Traditional farming methods, while effective in some regions, may not offer the best approach to optimize crop yield or reduce environmental impact. In response, "Smart-Agri Advisor" presents an innovative solution aimed at helping farmers make data-driven decisions that align with both environmental and market needs.

Modern agriculture faces two primary challenges: increasing food production and minimizing environmental harm. Unsustainable farming practices, such as the overuse of water, fertilizers, and pesticides, contribute to soil degradation and long-term environmental harm. At the same time, climate change has brought about unpredictable weather patterns, which directly impact crop growth and yield. Addressing these issues requires a shift toward smarter farming practices that leverage technology to make more informed decisions.

The Smart-Agri Advisor system is designed to aid farmers by providing real-time insights into crucial environmental factors and market trends. The system integrates advanced technologies, such as Internet of Things (IoT) sensors, data analysis, and machine learning algorithms, to analyze data from various sources, including soil quality, temperature, humidity, rainfall, and market demand. By analyzing this data, the system can suggest the most suitable crops for the current conditions and highlight optimal planting times. This enables farmers to make smarter choices about crop selection and resource allocation, which can increase yield and improve profitability.

1.8 Goals and Objectives

- **Data-Driven Crop Recommendations**: To Provides real-time, precise crop suggestions by integrating soil, weather, and market data.
- **Resource Optimization**: To Recommends efficient use of water and fertilizers to minimize waste and costs.
- **Automated Irrigation**: To Automates irrigation using soil moisture and weather data for optimal water usage.
- **Sustainable Farming**:To Promotes eco-friendly practices to support soil health and long-term sustainability.
- **Market Integration**:To Aligns crop choices with real-time market trends to maximize profitability.

1.9 Relevant mathematics associated with the Project

System Description:

- **Input:**
  - Soil data (nutrient levels, pH)
  - Weather data (temperature, humidity, rainfall)
  - Market data (price trends)
- **Output:**
  - Crop recommendations
  - Statistical data on soil and weather conditions
- **Data Structures & Classes:**
  - Use data frames (e.g., Pandas) for structured input storage
  - Dictionaries for mapping crop types with parameters
  - Classes for managing soil, weather, and market data objects

- **Parallel Processing:**
  - Employ divide-and-conquer methods to split data preprocessing, analysis, and machine learning tasks
  - Enable distributed/parallel processing for efficiency
- **Functions:**
  - Objects: Data objects representing soil, weather, and market data
  - Morphisms: Functions transforming raw data into features suitable for machine learning
  - Overloading: Use function overloading for preprocessing and analysis based on data type
  - Functional Relations: Relationships between soil and crop health, weather patterns and crop growth, and market trends for profit optimization
- **Mathematical Formulation:**
  - Use regression and clustering techniques for analyzing data
  - Calculate TF-IDF scores for textual data if analyzing reports
- **Success Conditions:**
  - High accuracy in crop recommendations
  - Efficient resource usage
  - Positive farmer feedback
- **Failure Conditions:**
  - Low accuracy
  - Misinterpretation of data
  - Inability to handle data variability or missing values

1.10 Names of Conferences / Journals where papers can be published

- IEEE/ACM Conference/Journal 1
- Conferences/workshops in IITs
- Central Universities or SPPU Conferences
- IEEE/ACM Conference/Journal 2

1.11 Review of Conference/Journal Papers supporting Project idea

1. J. Kwok, S. Yu, “A smart IoT-based irrigation system with automated plant recognition using deep learning,” In Proc. 10th International Conference on Computer Modeling and Simulation, 2018.

2. A. Vij, S. Vijendra, A. Jain, S. Bajaj, A. Bassi, A. Sharma, “IoT and Machine Learning Approaches for Automation of Farm Irrigation System,” *Procedia Computer Science*, vol. 167, pp. 1250-1257, 2020.

3. J. Tyszkiewicz, “IoT-Based Smart Irrigation System Using Artificial Intelligence,” *ScienceDirect*. Available:
https://www.sciencedirect.com/science/article/pii/S2772662223001510sec5

4. “A Comprehensive Overview of Smart Agriculture,” *TechRxiv*, Available:
https://www.techrxiv.org/doi/full/10.36227/techrxiv.23504496.v1

5. “Crop Recommendation System,” Available at:
https://www.researchgate.net/publication/

6. A. Sharma, “Advanced Crop Recommender Systems,” *IEEE Explore*, Available:
https://ieeexplore.ieee.org/document/9418351

7. “Smart Agriculture Data Processing Techniques,” Available:
https://web.p.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=1sid=99c255c7-b0bb-4c8c-b801-d9119e09a8d1

8. “Machine Learning in Agriculture: Case Study,” *IEEE Explore*, Available: https://ieeexplore.ieee.org/document/9398892

9. “Recent Advances in Precision Agriculture,” *IJRTI*, Available: https://www.ijrti.org/papers/IJRTI2212081.pdf

10. “Weather data: Free Weather API,” Available at: https://www.weatherapi.com/

1.12 Plan of Project Execution

- **Phase 1: Project Initialization and Planning**
  - **Timeline:** 1-2 Weeks
  - **Tasks:**
    * Define project objectives, scope, and requirements.
    * Conduct research on existing systems and gather datasets from agricultural universities, weather departments, and market conditions.
    * Set up project management tools and assign roles and responsibilities.
- **Phase 2: System Design and Architecture**
  - **Timeline:** 2 Weeks
  - **Tasks:**
    * Design the overall system architecture and data flow (including input sources, processing, machine learning, and outputs).
    * Define the data structures and classes required for the system.
    * Plan the database schema for efficient storage and retrieval of agricultural data.
    * Create UML diagrams (use-case, class, and sequence diagrams) to visualize system flow.
- **Phase 3: Data Collection and Preprocessing**
  - **Timeline:** 3 Weeks
  - **Tasks:**
    * Gather and integrate datasets from soil, weather, and market data sources.
    * Clean, normalize, and preprocess data to handle missing values, anomalies, and standardization.

    * Conduct feature engineering to extract useful features for machine learning models.
    * Store preprocessed data in the database for model training and testing.

- **Phase 4: Model Development and Training**
  - **Timeline:** 4-5 Weeks
  - **Tasks:**
    * Select appropriate algorithms for predictive analysis (e.g., regression, classification models).
    * Train machine learning models using preprocessed data to predict crop recommendations.
    * Fine-tune models based on accuracy and performance.
    * Validate models with test data and evaluate using metrics like accuracy, precision, and recall.

- **Phase 5: System Integration and UI Development**
  - **Timeline:** 3 Weeks
  - **Tasks:**
    * Develop user interfaces (UI) for data input, visualization, and crop recommendation display.
    * Integrate the machine learning models with the UI for real-time recommendations.
    * Ensure seamless data flow from the input sources, through preprocessing, to the model, and finally to the UI.

- **Phase 6: Testing and Optimization**
  - **Timeline:** 2-3 Weeks
  - **Tasks:**

    * Conduct system testing for functionality, performance, and usability.
    * Test for data accuracy, model predictions, and interface responsiveness.
    * Gather feedback from initial users (e.g., farmers or agricultural experts) to improve the system.
    * Optimize algorithms, data flow, and interface elements based on feedback.

- **Phase 7: Deployment and Documentation**
  - **Timeline:** 1-2 Weeks
  - **Tasks:**
    * Deploy the system for real-time use, ensuring data security and scalability.
    * Write user manuals and technical documentation for future maintenance.
    * Conduct training sessions for users, if necessary.

Chapter 2

Technical Keywords

2.1 Area of Project

Agriculture , AI, ML

2.2 Technical Keywords

Technical Keywords:

- Agriculture
- Data Analytics
- Machine Learning
- Internet of Things (IoT)

Chapter 3

INTRODUCTION

3.1 Project Title

Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability.

3.2 Project Domain

Data Analytics, Machine Learning

3.3 Introduction

Agriculture is the backbone of the world economy, helping to feed the growing population and support people's livelihoods, especially in rural areas. However, farming faces big challenges, such as the need to produce more food, limited natural resources, and unpredictable weather. Traditional farming methods often rely on experience or outdated techniques that don't take modern farming complexities into account, leading to wasted resources and lower crop yields. Recently, technology has brought about precision agriculture, which uses tools like smart sensors, data analysis, and machine learning to help farmers make better decisions. This approach improves productivity, reduces waste, and lessens the impact on the environment. Precision agriculture helps farmers use water, fertilizers, and energy more efficiently while growing more food and promoting sustainability. At the core of precision farming is the use of real-time data from different sources. Factors like soil health, weather, and crop prices all play important roles in a successful farming season. "Smart-Agri Advisor" is a system designed to help farmers by providing personalized crop suggestions and improving how they use resources. It combines environmental data and market information to give farmers clear and useful insights, helping them choose the best crops, manage irrigation, and adopt sustainable farming practices. Smart-Agri Advisor meets a key need in today's agriculture: combining large amounts of data from various sources and turning it into easy-to-understand advice for farmers. By automating complex decision-making, the system helps farmers get higher crop yields with fewer resources, supporting both economic and environmental sustainability. The system also helps reduce the uncertainty farmers face when making decisions, especially with the changing climate and market conditions that can affect how profitable crops are. By using real-time data on soil, weather, and prices, Smart-Agri Advisor provides precise recommendations for planning crop cycles and managing resources efficiently. This paper explores how Smart-Agri Advisor is designed and works, showing how it combines soil data, weather, and market trends to give accurate crop recommendations. It also looks at how the system can automate irrigation using real-time data on moisture and weather, helping farmers use water more effectively, especially in areas with water shortages. Additionally, the system promotes sustainable farming by recommending crops that not only increase yields but also protect soil health and biodiversity.

3.4 Scope of Project

Market Trend Analysis Integration: Integrate real-time agricultural market trends and pricing data into the system. This feature will allow farmers to align their crop choices and planting schedules with current market demands and potential future trends, optimizing profitability and market responsiveness.

3.5 Purpose of Study

The purpose of this study is to develop a data-driven system, Smart-Agri Advisor, to assist farmers in making informed crop selection and resource management decisions. By leveraging real-time data from soil, weather, and market conditions, the study aims to enhance agricultural productivity, optimize resource use, and promote sustainable farming practices. Through advanced data analysis and machine learning techniques, the system provides actionable insights that align with market demands and environmental conditions, ultimately supporting farmers in improving yields, reducing costs, and fostering long-term agricultural sustainability.

Chapter 4

LITERATURE SURVEY

Literature survey is the most important step in any kind of research. Before start developing we need to study the previous papers of our domain which we are working and on the basis of study we can predict or generate the drawback and start working with the reference of previous papers.

In this section, we briefly review the related work on Text classification and their different techniques.

1. ‘In the paper, ”IoT Based Smart Plant Irrigation System with Enhanced Learning,” author discuss the inefficiencies present in conventional irrigation models, which often rely on static systems unable to adapt to environmental variability. These traditional systems are prone to inefficient water use and lack mechanisms to learn from changing conditions. The paper addresses these limitations by incorporating machine learning techniques to improve water management. The authors utilized advanced algorithms such as Gradient Boosting Regression Trees (GBRT), Random Forest Regression, Support Vector Regression (SVR), and Artificial Neural Networks (ANNs) to enhance the decision-making process within the irrigation system. Key parameters considered include environmental factors such as humidity, temperature, and soil moisture, along with plant-specific characteristics and system-related variables. Additionally, machine learning parameters were integrated to ensure the models could adapt and optimize water use dynamically. This approach addresses the core issues of static models by incorporating an adaptive system capable of learning over time, ensuring both effective irrigation and resource conservation.

2. The paper titled "IoT-Based Smart Irrigation System Using Artificial Intelligence" explores the application of advanced technologies to address key challenges in traditional irrigation practices. The authors highlight significant problems such as inefficiencies in water usage, water scarcity, and the lack of real-time monitoring, which hinder effective resource management in agriculture. To overcome these limitations, the proposed system leverages Internet of Things (IoT) technology combined with artificial intelligence (AI) to enable predictive modelling and decision-making processes. The system collects and preprocesses data from IoT sensors installed on the field, which is then analyzed using predictive models and AI algorithms to make timely and accurate irrigation decisions. The paper considers several crucial parameters, including sensor data accuracy, predictive analytics capabilities, system performance metrics, scalability, and both economic and environmental impacts. The results of this study demonstrate that networking technology, particularly IoT, plays a critical role in modern agriculture by enabling real-time data collection and remote management, leading to more efficient and sustainable farming practices.

3. The paper named as "Crop Recommender System Using Machine Learning Approach"[7] discusses the challenges in India's agricultural sector, including low crop yield per hectare compared to global standards, contributing to farmer distress. It proposes a yield prediction system that connects farmers via a mobile application, using GPS to detect location and gathering inputs like area and soil type. The system employs machine learning algorithms, including Support Vector Machine (SVM), Artificial Neural Network (ANN), Random Forest (RF), Multivariate Linear Regression (MLR), and K-Nearest Neighbor (KNN), to predict yield. Random Forest delivered the best accuracy at 95

4. The paper titled "ENSEMBLED CROPIFY – Crop Fertilizer Recommender System"[5] addresses the challenges of inefficient crop selection and fertilizer use in Indian agriculture, resulting in reduced yields and financial losses for farmers. The proposed system uses machine learning algorithms [5] to recommend the optimal crop based on soil parameters like moisture, pH, temperature, and pressure. Additionally, it suggests suitable fertilizers based on environmental conditions. The system integrates a deep neural network [5] model to predict leaf diseases from images, offering immediate treatment recommendations for infected crops, ensuring higher yield and quality output.

5. The paper titled "Agricultural Crop Recommendation System"[6] presents a

machine learning-based approach for providing crop recommendations tailored to individual farming conditions. The system collects and analyzes data such as soil quality, climate, and historical yields to make personalized crop suggestions for farmers. By utilizing artificial intelligence, the system aims to optimize crop production, reduce costs, and enhance agricultural efficiency. Accessible via a web or mobile platform, the tool empowers farmers to make informed decisions, promoting sustainability and profitability while increasing overall productivity in the agricultural sector.

Chapter 5

REASEARCH GAP ANALYSIS

5.1

Limited integration of soil and weather data:
Most existing research focuses on either soil or weather data, but not both.

Limited farmer adoption and user experience:
Many crop recommendation systems are not user-friendly or fail to account for farmer preferences.

Insufficient use of machine learning algorithms:
While machine learning is widely used in agriculture, its application in crop recommendation systems is still limited.

Chapter 6

METHODOLOGY

6.1 Problem Statement

Nowadays because of unpredictable weather and market conditions it is difficult for farmers to choose, manage their yields, to solve this problem we are presenting a software which will consider and solve above problems.

6.2 Objectives

- Data-Driven Crop Recommendations: To provide real-time, precise crop suggestions by integrating soil, weather, and market data.
- Resource Optimization: To recommend efficient use of water and fertilizers to minimize waste and costs.
- Automated Irrigation: To automate irrigation using soil moisture and weather data for optimal water usage.
- Sustainable Farming: To promote eco-friendly practices to support soil health and long-term sustainability.
- Market Integration: To align crop choices with real-time market trends to maximize profitability.

6.3 Scope

- The scope of the "Smart-Agri Advisor" project is to provide farmers with real-time, data-driven crop recommendations by integrating soil, weather, and market conditions. It also aims to optimize resource usage and automate irrigation, promoting sustainable and profitable farming practices.

6.4 Proposed System Architecture

The system architecture of the "Smart-Agri Advisor" is designed to integrate various data sources and provide actionable insights for farmers. Here's a breakdown of the proposed architecture:

The proposed system architecture for the "Smart-Agri Advisor" project involves integrating multiple data sources and leveraging machine learning for intelligent recommendations. The system will collect data from:

- Agricultural universities, providing insights on soil types, crop varieties, and best practices.

- Weather departments, offering real-time and forecasted weather conditions such as temperature, rainfall, and humidity.

- Daily market conditions, giving real-time pricing and demand trends for various crops.

Once this data is aggregated, it undergoes several preprocessing techniques such as cleaning, normalization, and transformation to ensure consistency and accuracy. The preprocessed data is then fed into machine learning algorithms, which analyze patterns and trends based on factors like soil quality, climate conditions, and market demand.

These algorithms generate recommendations such as optimal crop choices, irrigation schedules, and resource management strategies. The system outputs these derived insights through a user-friendly interface, providing actionable information to farmers for data-driven decision-making.

This architecture ensures the seamless collection, processing, and analysis of large datasets from diverse sources, ultimately providing farmers with reliable and precise recommendations to enhance agricultural productivity and sustainability.

6.4.1 Steps of the System Architecture

1. **Data Processing Layer**

   - **Data Aggregation**: Gathers and compiles data from various sensors and external sources.

   - **Data Preprocessing**: Cleans and normalizes the collected data to make it suitable for analysis.

2. **Analysis & Prediction Layer**

   - **Machine Learning Algorithms**: Analyze the preprocessed data to generate crop recommendations based on soil conditions, weather forecasts, and market trends.

   - **Predictive Models**: Forecast crop yield, weather changes, and resource requirements like water and fertilizer.

3. **Recommendation System**

   - **Crop Suggestion Engine**: Provides real-time crop recommendations that optimize yield, sustainability, and profitability.

   - **Irrigation and Resource Optimization**: Recommends optimal irrigation schedules and resource usage based on sensor data.

4. **User Interface Layer**

   - **Web/Mobile Application**: A user-friendly platform where farmers can access crop recommendations, resource management insights, and market data.

   - **Alert System**: Provides notifications for actions like irrigation, crop health management, and market changes.

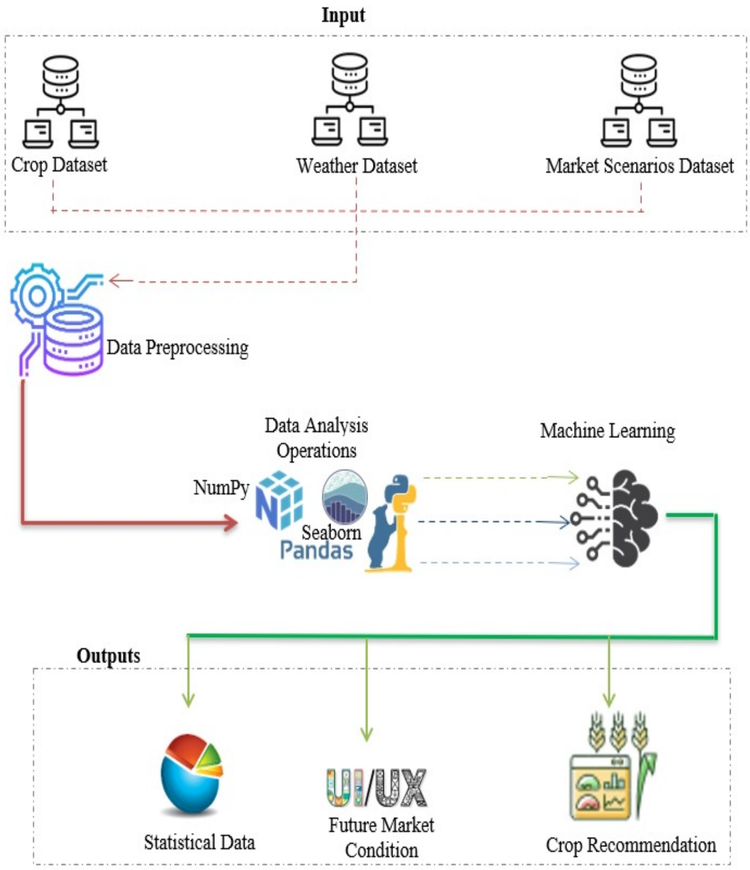


Figure 6.1: System Architecture

Sr. No.	Existing System:	Proposed System:
1	In existing system use logistic regression.	In proposed used advanced K means clustering algorithm for text classification.
2	In existing system worked on bag of words method.	In proposed system, worked on semantic level and removed bag of words drawbacks.

6.5 Motivation

With the advent of smart farming technologies, there is a growing need to develop systems that not only enhance agricultural productivity but also ensure sustainability and resource optimization. The motivation behind the ”Smart-Agri Advisor” project stems from the need to assist farmers in overcoming challenges like water scarcity, soil degradation, fluctuating market conditions, and climate unpredictability. By utilizing data from various sensors and integrating real-time market data, Smart-Agri Advisor aims to empower farmers with actionable insights to improve crop selection, irrigation management, and resource usage. The project seeks to demonstrate how intelligent systems can address pressing issues in agriculture, making farming more efficient and sustainable.

6.6 Major Constraints

The major constraints in the "Smart-Agri Advisor" project include:

1. **Cost**: Developing and implementing the system requires significant investment in hardware (e.g. servers), software (development, integration), and ongoing data subscriptions (weather and market data). Additionally, maintaining real-time data processing, cloud services, and IoT infrastructure can increase operational costs.

2. **Time**: Building a robust system from scratch, including data integration, machine learning algorithms, testing, and deployment, can be time-consuming. Gathering reliable data from agricultural universities, weather departments, and market sources also adds to the timeline.

3. **Technical Complexity**: Integrating various data sources, preprocessing the data, and developing accurate machine learning models requires advanced technical expertise. Ensuring real-time data collection and processing, as well as scalability, adds to the complexity of the system.

4. **Scope Creep**: The project involves multiple components (e.g., soil sensors, weather data, market analysis), making it prone to scope expansion. Managing feature additions without deviating from the core goals of the project will be a challenge.

5. **Infrastructure and Connectivity**: In rural areas, limited internet access can hinder the system's real-time data collection and communication. Additionally, setting up the required infrastructure (e.g., sensors, IoT devices) can be complex and expensive.

6.7 Application

1. **Precision Farming**: Provides real-time, data-driven crop recommendations for optimal yield.

2. **Resource Optimization**: Enhances efficient use of water, fertilizers, and pesticides.

3. **Automated Irrigation**: Automates irrigation based on soil and weather data.

4. **Market-Driven Decisions**: Aligns crop choices with real-time market trends for better profitability.

5. **Sustainable Agriculture**: Encourages eco-friendly farming practices.

6. **Risk Mitigation**: Helps farmers anticipate risks with predictive analytics on weather and market conditions.

6.8 Advantages and Disadvantages

6.8.1 Advantages

- Data-driven recommendations for optimal crop choices.
- Reduces water and fertilizer usage through smart insights.
- Saves time and labor with intelligent irrigation control.
- Aligns farming decisions with market demands for higher profits.
- Promotes eco-friendly and sustainable farming practices.

6.8.2 Disadvantages

- Setup of sensors, software, and infrastructure can be expensive.
- Requires advanced technical expertise for data integration and machine learning models.
- Limited internet access in rural areas may hinder real-time data processing.
- Inaccurate or incomplete data can lead to suboptimal recommendations.

6.9 Methodologies/ Algorithm Details

6.9.1 Mathematical Model

Inputs Let the following parameters represent inputs to the system:

- **S**: Soil data

$$S = [N, P, K, \text{pH}, \text{moisture}, \dots]$$

- Nitrogen (N), Phosphorus (P), Potassium (K), pH levels, soil moisture content, etc.

- **W**: Weather data

$$W = [T, H, R]$$

  - Temperature (T), Humidity (H), Rainfall (R), etc.

- **M**: Market data

$$M = [P_c, D_c]$$

  - Crop price (P_c), Crop demand (D_c), etc.

- **A**: Agricultural research data from universities and external sources, including best practices and crop recommendations.

6.9.2 Preprocessing

Data preprocessing involves standardizing and normalizing data. For example:

- **Normalized Soil Data (S')**:

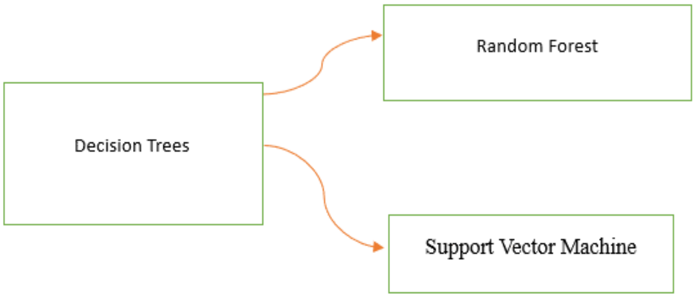
$$S' = \frac{S - S_{\min}}{S_{\max} - S_{\min}}$$

- **Normalized Weather Data (W')**: Similar normalization is applied to weather data.

6.9.3 Machine Learning Model

The system uses a predictive model, such as:

- Decision Tree
- Random Forest
- Neural Network



These models are used to recommend crops based on the input data, which includes soil, weather, and market conditions.

where, SD (I_i^j, I_j^k), called the semantic distance, is the minimum number of between I_i^j and I_j^k in the ontology, and R is a constraint to define the semantic distance range.

Finally Classification using Machine Learning Framework.

Mathematical Terms

Let us consider S as a System for Document Classification.
S=$\{I, F, O\}$
Where, I = Text Dataset Uploaded by the User
F = Functions Implemented to get the Output
O = Output i.e. Document Clustering

INPUT:

Identify the inputs:
Set,
F = $\{f_1, f_2, f_3, ..., f_n\}$
Where, F is Set of Functions to Execute Commands.
I = $\{i_1, i_2, i_3, ..., i_n\}$
Where, I is Set of Inputs to the Function Set
O = $\{o_1, o_2, o_3, ...o_n\}$
Where, O is Set of Outputs from the Function Sets.

6.9.4 Details of Algorithms

(a) **pre-processing Algorithms:**

i. Stop word Removal-This technique remove stop words like is, are, they, but etc.

ii. Tokenization-This technique remove Special character and images.

iii. Stemming – remove suffix and prefix and Find Original word for e.g.-

A. Played – play

B. Clustering – cluster

(b) **TFIDF Algorithm**

The tf–idf score for term Iij is calculated using the term frequency and the document frequency. Term frequency (tf) and inverse document frequency (idf) are the foundations of the most popular term weighting scheme in IR. The tf–idf score of Iij , tf—idf(Iij), is computed as:

tf-idf(I_i^j) log(tf(I_i^j,d_j)+1) * log($|D|$/1+df(I_i^j,D))

(c) **K- means Clustering:**

K-Means is the one of the unsupervised learning algorithm for clusters. Clustering the image is grouping the pixels according to the same characteristics. In the k-means algorithm initially we have to define the number of clusters k. Then k-cluster center are chosen randomly. The distance between the each pixel to each cluster centers are calculated. The distance may be of simple Euclidean function. Single pixel is compared to all cluster centers using the distance formula. The pixel is moved to particular cluster which has shortest distance among all. Then the centroid is re-estimated. Again each pixel is compared to all centroids. The process continuous until the center converges.

(d) **Principal Component Analysis:**

To apply PCA on your crop production data, first load the CSV file. Then, clean the data by handling any missing values and scaling the features. Next, apply PCA to reduce the number of features while keeping the important information. After that, you can use the reduced data for analysis or prediction tasks.

6.10 Functional Model and Non-functional Model

6.10.1 Functional Requirements

(a) **System Features:**
i. The system proposes a Smart-Agri Advisor that provides crop recommendations and resource management based on data from agricultural universities, weather departments, and real-time market conditions. It processes the input data, applies machine learning algorithms, and outputs crop suggestions, irrigation schedules, and market-driven insights.

(b) **External Interface Requirements:**

i. **User Interface:**

A. Home Page: Provides an overview of the system, its purpose, and easy access to all main functionalities.

B. Upload Data Page: Allows users to upload datasets from agricultural universities, weather reports, and market trends.

C. Apply Preprocessing Page: Facilitates data preprocessing steps like cleaning, normalization, and transformation of raw data.

D. Apply Machine Learning Page: Enables users to apply machine learning models to the processed data to predict the best crop recommendations.

E. View Insights Page: Displays the output, including recommended crops, irrigation schedules, and market analysis, in a user-friendly format.

ii. **Hardware Interfaces:**
The entire software requires a completely equipped computer system including monitor, keyboard, and other input output devices.

iii. **Software Interfaces:**
The system can use Microsoft as the operating system platform. System also makes use of certain GUI tools. To run this application we need JDK 1.8 and above as java platform and Apache tomcat as server. To store data we need MySQL database.

6.10.2 Non-Functional Requirements

(a) **Performance:**
The system should process large datasets efficiently and provide crop recommendations in real-time (response time under 5 seconds).

(b) **Scalability:**
The system should be capable of handling growing data input from multiple sources, including sensors, market data, and weather forecasts.

(c) **Usability:** The user interface must be simple and intuitive, especially for users with minimal technical knowledge (i.e., farmers). Navigation should be straightforward with clear labeling.

(d) **Reliability:** The system should maintain a high level of accuracy in recommendations (90) by continuously updating its datasets and models.

(e) **Security:** All data, including user inputs and agricultural data, must be encrypted and protected from unauthorized access.

(f) **Maintainability:** The system should be easy to update and maintain, allowing future integration of more advanced algorithms and data sources.

(g) **Data Privacy:** Personal data and market-sensitive information should be handled in accordance with data protection regulations to ensure user privacy.

6.11 Risk Identification

In the face of growing challenges in modern agriculture, farmers need precise and sustainable methods to enhance crop yield while managing resources effectively.

6.11.1 Risk Analysis

Risk analysis in modern agriculture is essential for maximizing crop yield and promoting sustainability. Accurate crop recommendations are critical in this process, as they enable farmers to make informed decisions that can significantly impact their productivity and resource management. The Smart-Agri Advisor is a cutting-edge tool that leverages extensive data on soil and environmental factors, including nutrient levels, moisture content, and weather conditions, to provide tailored recommendations for farmers.

ID	Risk Description	Probability	Impact		
			Schedule	Quality	Overall
1	Conflicts between users and developers	Low	Low	High	High
2	Unclear system requirements	Low	Low	High	High
2	Lack of training on tools and Inexperience.	Low	Low	High	High

Table 6.1: Risk Table

6.12 Overview of Risk Mitigation, Monitoring, and Management

6.12.1 Risk Mitigation

- **Ensure Data Quality**: Implement validation techniques to ensure accurate data.

Probability	Value	Description
High	Probability of occurrence is	$> 75\%$
Medium	Probability of occurrence is	$26 - 75\%$
Low	Probability of occurrence is	$< 25\%$

Table 6.2: Risk Probability Definitions

Impact	Value	Description
Very high	$> 10\%$	Schedule impact or Unacceptable quality
High	$5 - 10\%$	Schedule impact or Some parts of the project have low quality
Medium	$< 5\%$	Schedule impact or Barely noticeable degradation in quality Low Impact on schedule or Quality can be incorporated

Table 6.3: Risk Impact Definitions

- **Redundant Systems**: Use backup sensors and manual overrides for irrigation.
- **Real-Time Updates**: Regularly update market data to keep recommendations relevant.
- **User Training**: Provide training to encourage technology adoption by farmers.

6.12.2 Monitoring and Management

- **Regular Audits and Diagnostics**: Continuously monitor data and sensors.
- **Market Reviews**: Periodically review and update market data.
- **Feedback Loops**: Collect farmer feedback to improve the system.
- **Contingency Planning**: Prepare alternative strategies for identified risks.

Risk ID	1
Risk Description	Conflicts between users and developers
Category	Development Environment.
Source	Software requirement Specification document.
Probability	Low
Impact	High
Response	Mitigate
Strategy	Strategy
Risk Status	Occurred

Risk ID	2
Risk Description	Unclear system requirements
Category	Requirements
Source	Software Design Specification documentation review.
Probability	Low
Impact	High
Response	Mitigate
Strategy	Better testing will resolve this issue.
Risk Status	Identified

Risk ID	3
Risk Description	Lack of training on tools and Inexperience.
Category	Technology
Source	This was identified during early development and testing.
Probability	Low
Impact	Very High
Response	Accept
Strategy	Example Running Service Registry behind proxy balancer
Risk Status	Identified

Chapter 7

TOOLS AND PLATFORM

7.1 Hardware Requirements

1. Processor - AMD - A6
2. Speed - 1.1 GHz
3. RAM - 256 MB(min)
4. Hard Disk - 20 GB
5. Floppy Drive - 1.44 MB
6. Key Board - Standard Windows Keyboard
7. Mouse - Two or Three Button Mouse
8. Monitor - SVGA

7.2 Software Requirements

1. Operating System - Windows
2. Application Server - Apache Tomcat
3. Front End - HTML,CSS(SCSS),JS
4. Scripts - JavaScript.
5. Server side Script - Java Server Pages.

6. Database - My SQL 5.0
7. IDE - Eclipse,VScode

Chapter 8

PROJECT IMPLEMENTATION AND DESIGN

8.1 Introduction

Implementation simply means carrying out the activities described in our work plan. Project Implementation is the phase where vision and plans become reality. This is the logical conclusion, after evaluating, deciding, visioning, planning, applying for fund and finding the financial resources of a project. The basic requirement for starting the implementation process is to have the work plan ready and understood by all the actor involved. Technical and non-technical requirement have to be clearly defined and the financial, technical and institutional framework of the specific project have to be prepared considering the local conditions.

8.2 Tool and Technologies Used

1. HTML, JDK 1.7, JSP
2. Backend: Mysql 5.0
3. IDE : Eclipse Oxygen
4. Application Server - Apache Tomcat
5. Star UML, LaTeX, PDF Files.

8.3 Data Flow Diagram

1. **Data Collection**

   (a) **Soil Data**: Includes data from agricultural universities and soil testing, providing information like nutrient levels (e.g., Nitrogen, Phosphorus, Potassium), pH values, and more.

   (b) **Weather Data**: Information from weather departments, such as temperature, humidity, and rainfall, which is essential for crop planning and irrigation schedules.

   (c) **Market Condition Data**: Real-time market data, including trends and pricing for crops, helping farmers make economically informed decisions.

2. **Data Preprocessing**

   (a) **Preprocessing Stage**: All the input data is sent to the Data Preprocessing stage. Here, the data is cleaned, normalized, and formatted to make it suitable for further processing. This step ensures that the inputs are structured uniformly and that irrelevant or erroneous data is removed.

3. **Data Analysis Operations**

   (a) **Analysis Tools**: After preprocessing, the data is subjected to analytical operations using libraries like NumPy and Pandas.

      - **NumPy**: Handles numerical computations and operations on large datasets efficiently.
      - **Pandas**: Used for data manipulation and analysis, especially with tabular data formats.

4. **Machine Learning**

   - After data analysis, the cleaned and processed data is fed into the Machine Learning (ML) module.
   - This module involves training models that can predict optimal crops based on the provided inputs (soil, weather, and market conditions).

5. **Outputs**

- The results of the data analysis and machine learning process are split into two main outputs:

  (a) **Statistical Data**: This output provides a detailed report on the state of the soil, weather, and market conditions, giving the farmer actionable insights in a comprehensive manner.

  (b) **Crop Recommendations**: Based on the analysis, the system generates a list of crop recommendations tailored to the current environmental and economic conditions. This allows farmers to make informed decisions that maximize yield and profitability.

- **UX/UI Interface**: The entire system's outputs are presented through a UI/UX interface, which is designed for ease of use. It ensures that farmers and stakeholders can interact with the data and insights in an intuitive and efficient manner.

Data Flow Diagram Level 0

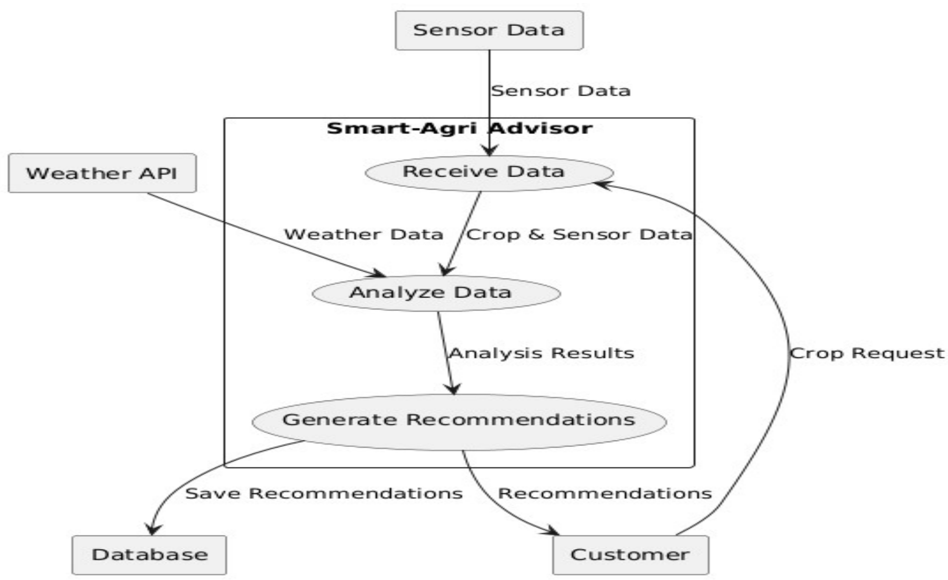


Figure 8.1: Data Flow Diagram Level 0

Data Flow Diagram Level 1

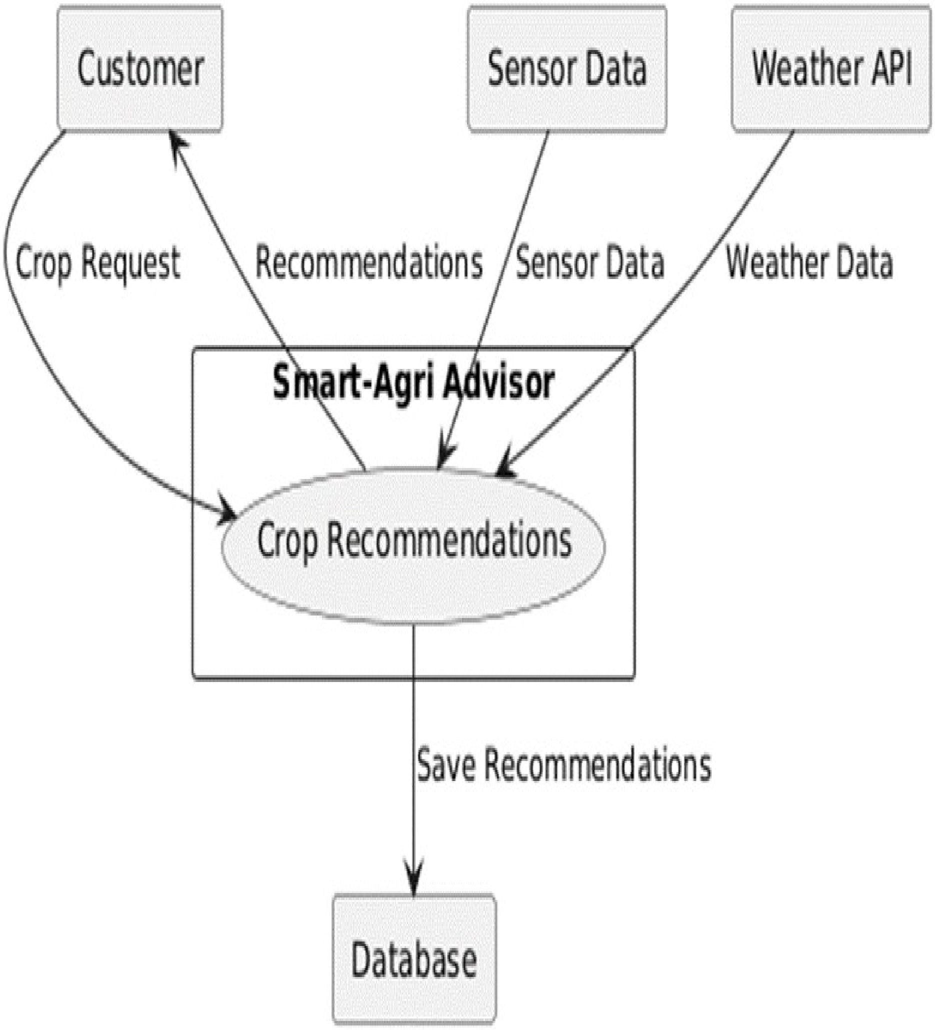


Figure 8.2: Data Flow Diagram Level 1

Data Flow Diagram Level 2

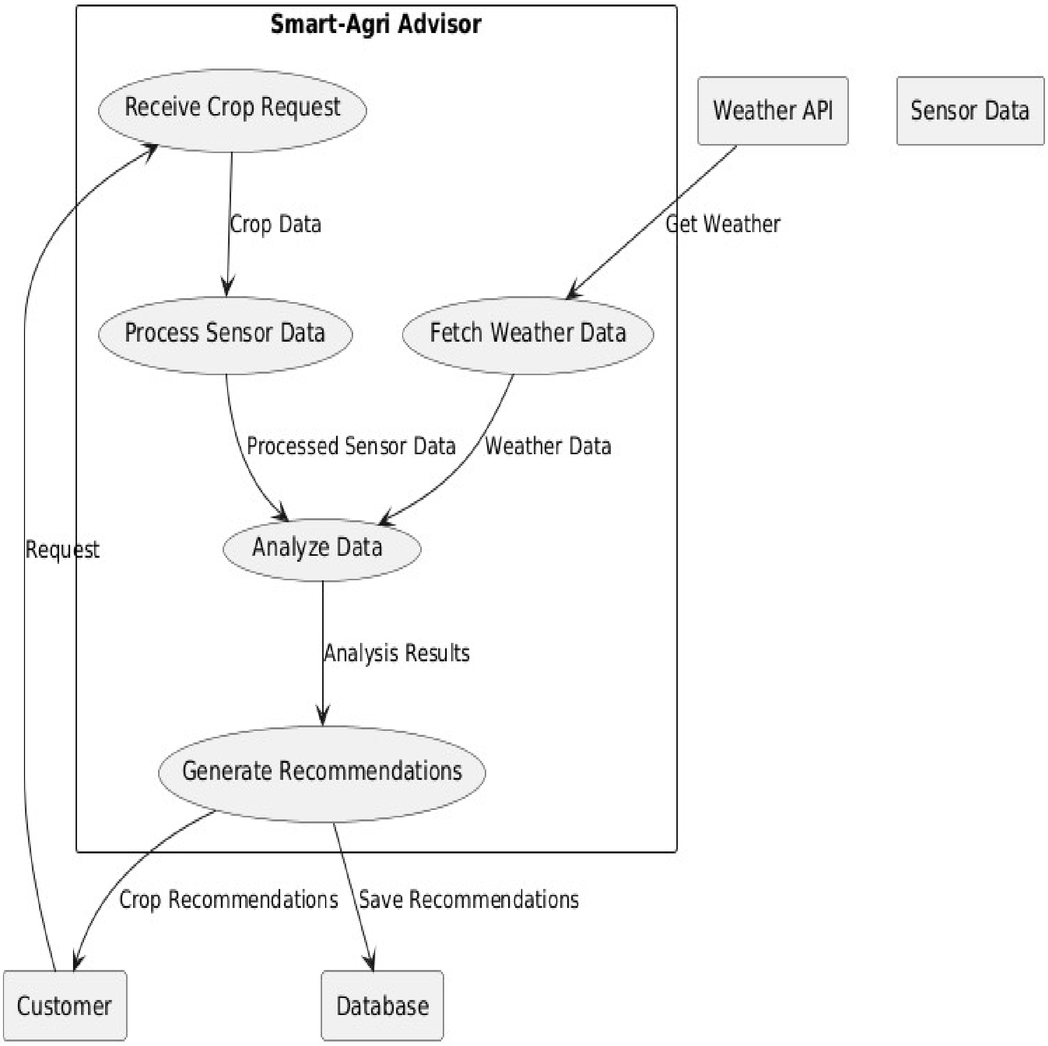


Figure 8.3: Data Flow Diagram Level 2

8.4 UML Diagram

8.4.1 Use Case Diagram

Sr No.	Use Case	Description	Actors	Assumptions
1	Use Case 1	Create a Login	Admin	It can Create a Login, Upload Dataset and Train the Data
2	Use Case 1	Create a Registration	User	It can Create a Registration, and give the Output

Table 8.1: Use Cases

Use Case Diagram: Use Case Diagram is a diagram that shows a set of use cases and actors and their relationships. A Use case diagram is a type of behavioral diagram depend by the UML created from Use case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals represented as use case and any dependencies between those use cases

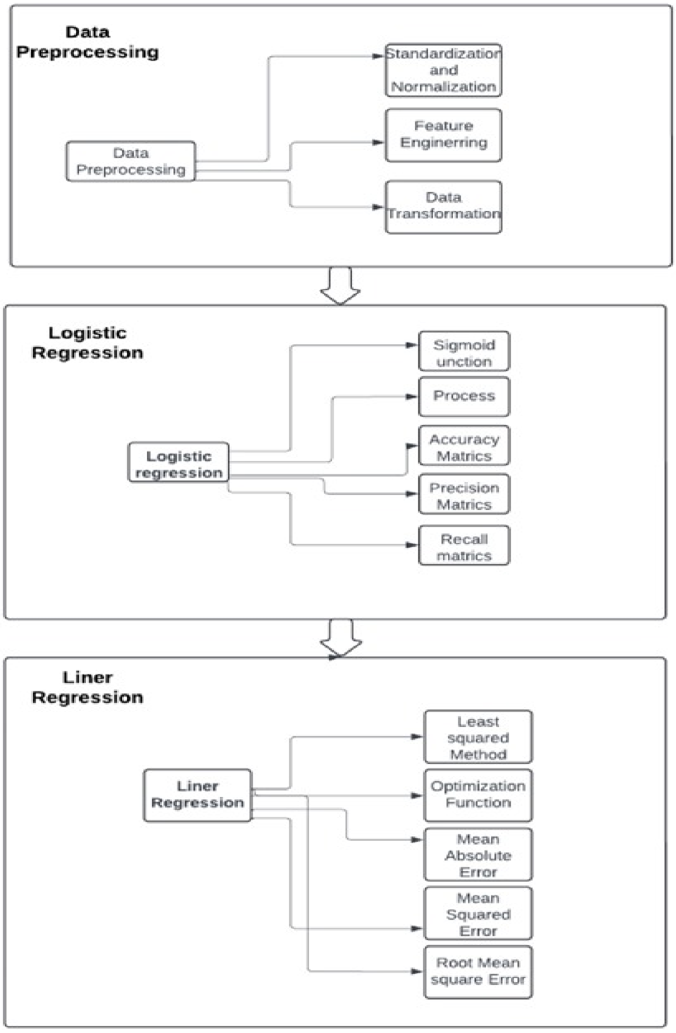


Figure 8.4: Use Case Diagram

8.4.2 Class Diagram

Class diagram is a diagram that shows a set of classes, interfaces and collaborations and their relationships. Class diagrams are important not only for visualizing, specifying and documenting structural models. But also for constructing executable system through forward and reverse engineering.

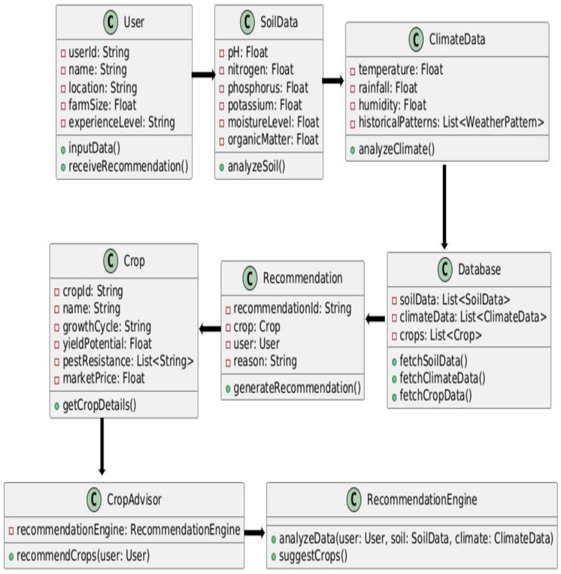


Figure 8.5: Class Diagram

8.4.3 Activity Diagram

Activity diagrams are used to model the behavior of a system, and the way in which these behaviours are related in an overall flow of the system. An Activity diagram is used for modeling the dynamic features of a system. An activity diagrams consist of flowchart, which shows the flow of control from one activity to another activity.

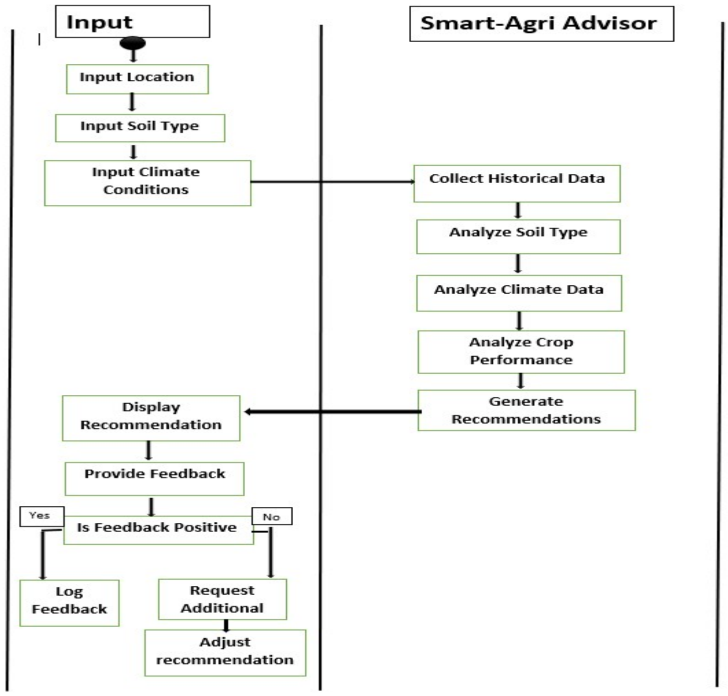


Figure 8.6: Activity Diagram

8.4.4 Component Diagram

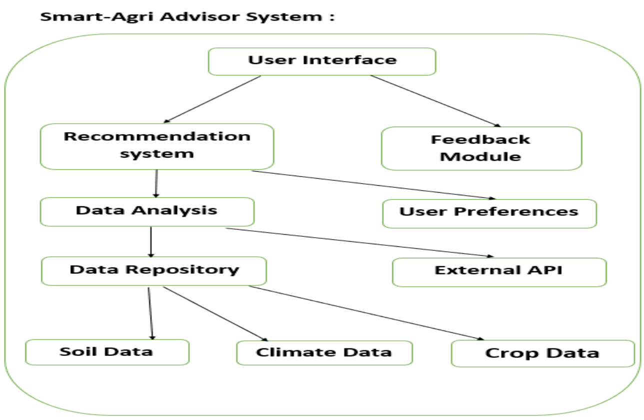


Figure 8.7: Component Diagram

8.4.5 Deployment Diagram

A deployment diagram showes how and where the system will be delpoyed.A deployment diagram is a diagram that shows the configuration of runtime processing nodes and the component that live on them.Graphically,a deployment diagram is a collection of vertices and arcs.

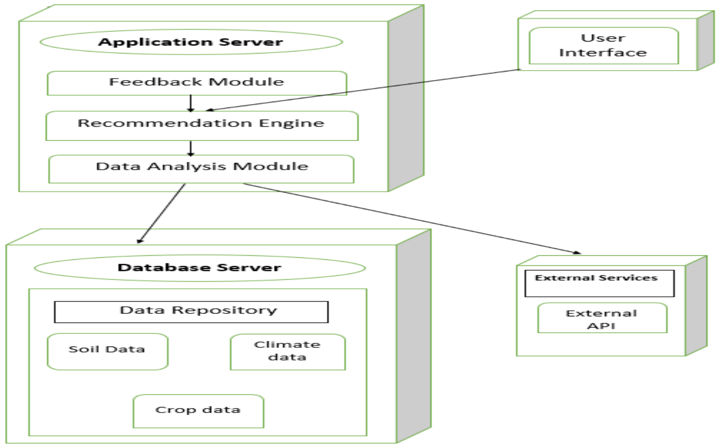


Figure 8.8: Deployment Diagram

8.5 Verification and Validation for Acceptance :

The validation of test methods covers a large extent the uncertainty, repeatability and re producibility of the test method. As the factors affecting the results and contributing most to the uncertainty, the change from one technical sector to another or even from one test method to another, a universal solution cannot be given. Validation tests cover following points,

- The user should pass the correct user name and password for login system.
- The validation provided for user login form to fill up all the fields.

Chapter 9

CONCLUSION

9.1 Future Scope

The future scope of the "Smart-Agri Advisor" project includes enhancements such as integrating advanced features like multi-word expressions and named entities for improved crop recommendations. Expanding data sources to encompass global market trends and real-time environmental data will increase precision. The project aims for scalability by creating accessible platforms for larger farms and remote areas, while exploring sophisticated AI and machine learning algorithms for better decision-making. Increasing IoT device usage for real-time irrigation adjustments and focusing on user training will facilitate technology adoption. Additionally, integrating international agricultural trends and promoting eco-friendly practices will enhance the system's support for sustainable and profitable farming.

9.2 Conclusion

The Smart-Agri Advisor system represents a significant step forward in optimizing agricultural practices through the application of data-driven insights and technology. By leveraging data from various sources, including soil, weather, and crop information, the system provides farmers with precise recommendations on crop selection, irrigation, and resource management. This ensures better productivity while promoting sustainable agricultural practices.

References

1. J. Kwok, S. Yu, “A smart IoT-based irrigation system with automated plant recognition using deep learning,” In Proc. 10th International Conference on Computer Modeling and Simulation, 2018.

2. A. Vij, S. Vijendra, A. Jain, S. Bajaj, A. Bassi, A. Sharma, “IoT and Machine Learning Approaches for Automation of Farm Irrigation System,” *Procedia Computer Science*, vol. 167, pp. 1250-1257, 2020.

3. J. Tyszkiewicz, “IoT-Based Smart Irrigation System Using Artificial Intelligence,” *ScienceDirect*. Available:
https://www.sciencedirect.com/science/article/pii/S2772662223001510sec5

4. “A Comprehensive Overview of Smart Agriculture,” *TechRxiv*, Available:
https://www.techrxiv.org/doi/full/10.36227/techrxiv.23504496.v1

5. “Crop Recommendation System,” Available at:
https://www.researchgate.net/publication/

6. A. Sharma, “Advanced Crop Recommender Systems,” *IEEE Explore*, Available:
https://ieeexplore.ieee.org/document/9418351

7. “Smart Agriculture Data Processing Techniques,” Available:
https://web.p.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=1sid=99c255c7-b0bb-4c8c-b801-d9119e09a8d1

8. “Machine Learning in Agriculture: Case Study,” *IEEE Explore*, Available:
https://ieeexplore.ieee.org/document/9398892

9. “Recent Advances in Precision Agriculture,” *IJRTI*, Available:
https://www.ijrti.org/papers/IJRTI2212081.pdf

10. “Weather data: Free Weather API,” Available at: https://www.weatherapi.com/

Appendix A

Call for Paper of Conference/Journal

A.1 Call for Paper of Conference

1. **Title:** "Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability"
   Name of Conference:nternational Journal for Research in Engineering Management
   Paper Accepted/Rejected : Accepted
   Action: Attendee


ISSN: 2582-3930

ACCEPTANCE CERTIFICATE

Impact Factor: 8.448
DOI Prefix: 10.55041

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING & MANAGEMENT (IJSREM)
An Open Access Scholarly Journal || Index in major Databases & Metadata

We are pleased to inform you that your Research Paper titled
Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability
has been ACCEPTED for publication in
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING & MANAGEMENT (IJSREM)
VOLUME 08 ISSUE 10 OCTOBER- 2024

We are delighted to see your commitment & hardwork to share your research is being recognized. We look foreward to helping you with all of your publication needs. Thank you for choosing IJSREM!!

Editor-in-chief
IJSREM

www.ijsrem.com
e-mail: editor@ijsrem.com

A.2 Call for Paper of Journal

1. **Title:** "Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability"
   Name of Journal: International Journal for Research in Engineering & Management.
   Paper Accepted/Rejected : Accepted
   Action: Published

Appendix B

Published Paper Along With Certificate of Presentation

B.1 Published Paper Certificate

1. **Journal**

    (a) **Title:** "Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability"
    Name of Journal: International Journal for Research in Engineering & Managment.
    Paper Accepted/Rejected : Accepted
    Action: Published

DOI: 10.55041/IJSREM37952

ISSN: 2582-3930

Impact Factor: 8.448

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING & MANAGEMENT

An Open Access Scholarly Journal || Index in major Databases & Metadata

CERTIFICATE OF PUBLICATION

International Journal of Scientific Research in Engineering & Management is hereby awarding this certificate to

Sase Vedant

in recognization to the publication of paper titled

Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability

published in IJSREM Journal on Volume 08 Issue 10 October, 2024

www.ijsrem.com

Editor-in-Chief
IJSREM Journal

e-mail: editor@ijsrem.com

DOI: 10.55041/IJSREM37952

ISSN: 2582-3930

Impact Factor: 8.448

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING & MANAGEMENT

An Open Access Scholarly Journal || Index in major Databases & Metadata

CERTIFICATE OF PUBLICATION

International Journal of Scientific Research in Engineering & Management is hereby awarding this certificate to

Somesh Chaudhari

in recognization to the publication of paper titled

Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability

published in IJSREM Journal on Volume 08 Issue 10 October, 2024

www.ijsrem.com

Editor-in-Chief
IJSREM Journal

e-mail: editor@ijsrem.com


DOI: 10.55041/IJSREM37952

ISSN: 2582-3930

Impact Factor: 8.448

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING & MANAGEMENT

An Open Access Scholarly Journal || Index in major Databases & Metadata

CERTIFICATE OF PUBLICATION

International Journal of Scientific Research in Engineering & Management is hereby awarding this certificate to

Prasad Patil

in recognization to the publication of paper titled

Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability

published in IJSREM Journal on Volume 08 Issue 10 October, 2024

www.ijsrem.com

Editor-in-Chief
IJSREM Journal

e-mail: editor@ijsrem.com


DOI: 10.55041/IJSREM37952

ISSN: 2582-3930

Impact Factor: 8.448

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING & MANAGEMENT

An Open Access Scholarly Journal || Index in major Databases & Metadata

CERTIFICATE OF PUBLICATION

International Journal of Scientific Research in Engineering & Management is hereby awarding this certificate to

Sunny Gangurde

in recognization to the publication of paper titled

Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability

published in IJSREM Journal on Volume 08 Issue 10 October, 2024

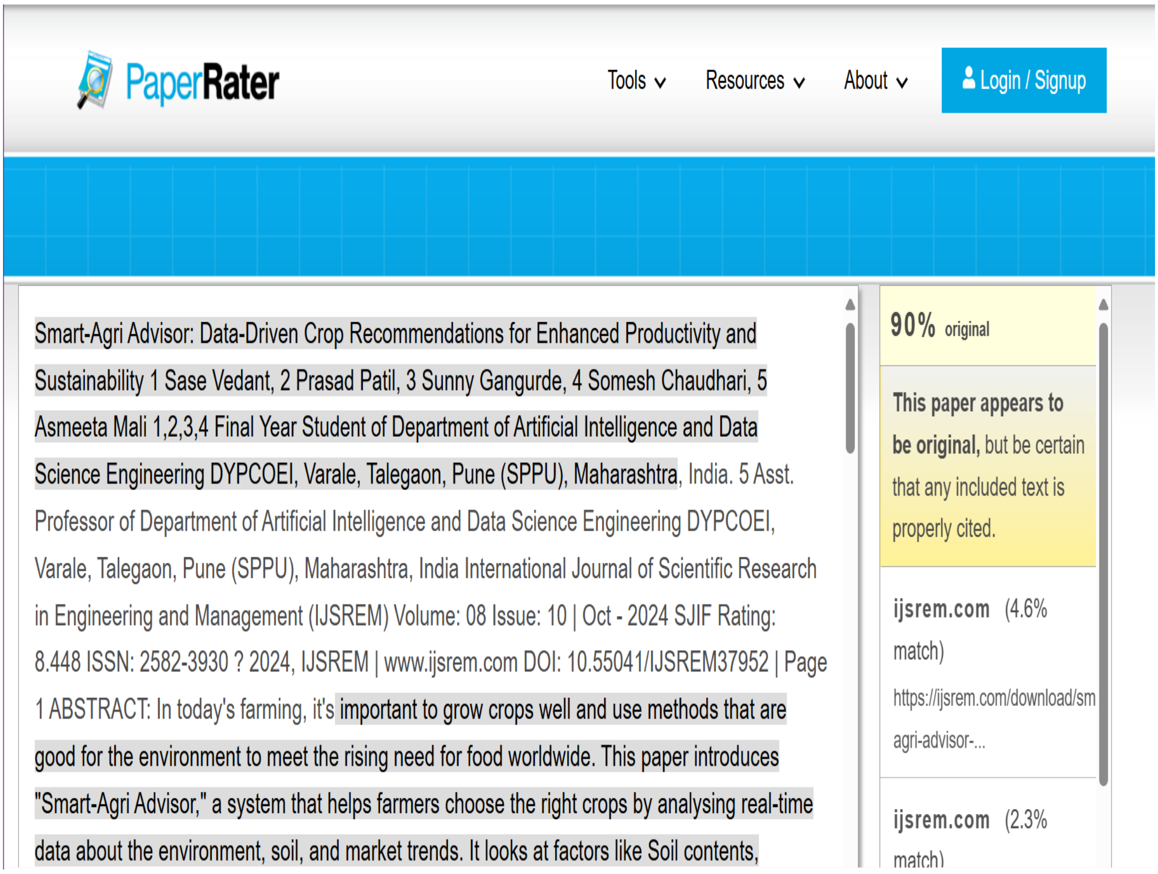
www.ijsrem.com

Editor-in-Chief
IJSREM Journal

e-mail: editor@ijsrem.com

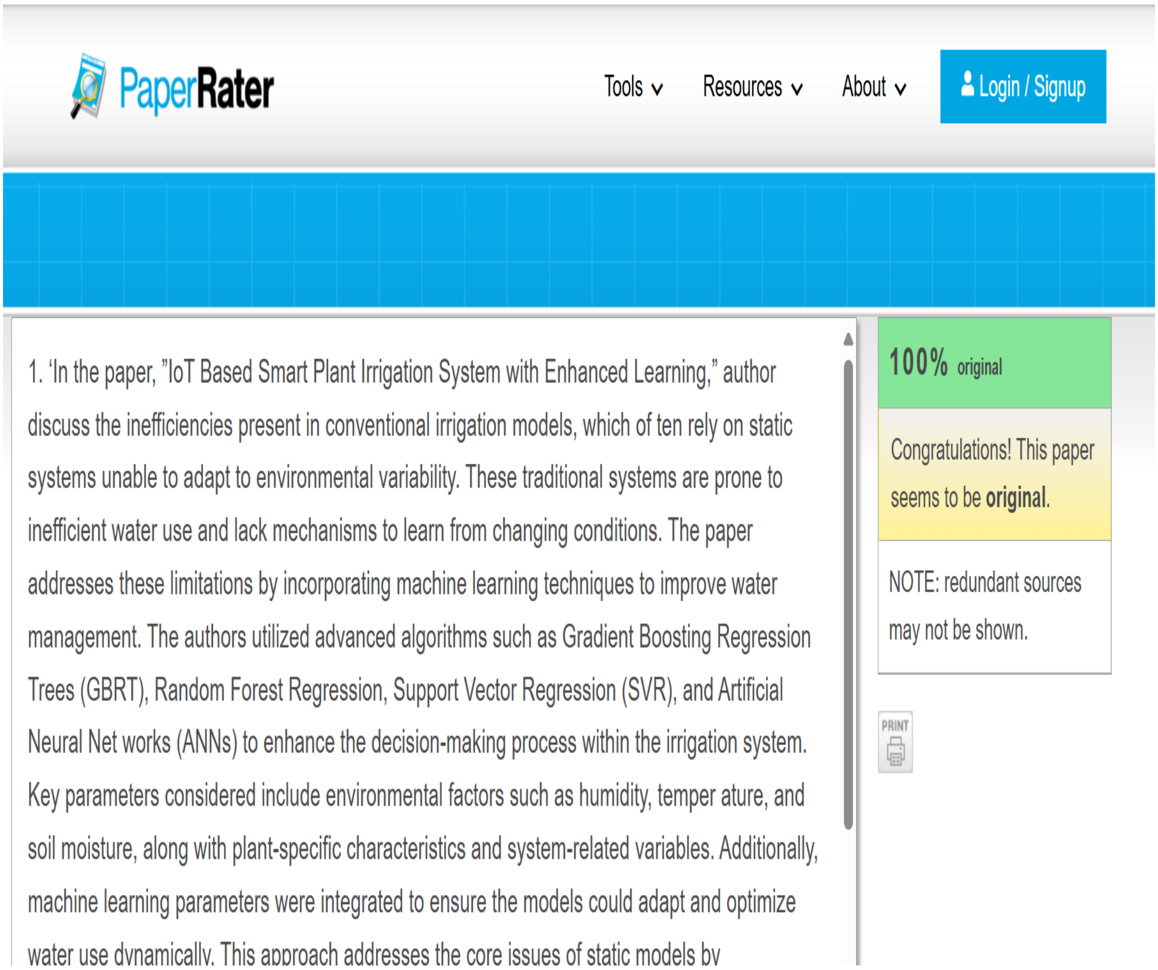
Appendix C

Plagiarism Report of Paper



Appendix D

Plagiarism Report of Thesis



Appendix E

Information of Project Group Members

1. Name : Sase Vedant Dilip
2. Date of Birth : 27/06/2003
3. Gender : Male
4. Permanent Address : At post Lohogaon, Tal-Newasa, Dist- Ahmednagar.
5. E-Mail : sasevedant5264@gmail.com
6. Mobile/Contact No. : 9307952128
7. Placement Details : Not Placed Yet
8. Paper Published : Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability

1. Name : Somesh Shesharao Chaudhari
2. Date of Birth :15/12/2002
3. Gender :Male
4. Permanent Address : Pimpri D TQ and DIST Jalna 431203
5. E-Mail : chaudharisomesh127@gmail.com
6. Mobile/Contact No. :9145223212
7. Placement Details :
8. Paper Published :Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability

1. Name : Prasad Prakash Patil
2. Date of Birth :08/08/2003
3. Gender :Male
4. Permanent Address : Gulmohar road , davli mala , sarvodaya colony , savedi, A.nagar
5. E-Mail : patilprasad8483@gmail.com
6. Mobile/Contact No. :8483985699
7. Placement Details :
8. Paper Published :Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability

1. Name : Sunny Nivrutti Gangurded
2. Date of Birth : 17/04/2004
3. Gender : Male
4. Permanent Address : At Post Nakode, Tal-Kalwan, Dist-Nashik, 423501
5. E-Mail : gangurdesunny2004@gmail.com
6. Mobile/Contact No. : 9322616471
7. Placement Details :
8. Paper Published : Smart-Agri Advisor: Data-Driven Crop Recommendations for Enhanced Productivity and Sustainability