

**VIJAYANAGARA SRIKRISHNADEVARAYA UNIVERSITY
BALLARI**



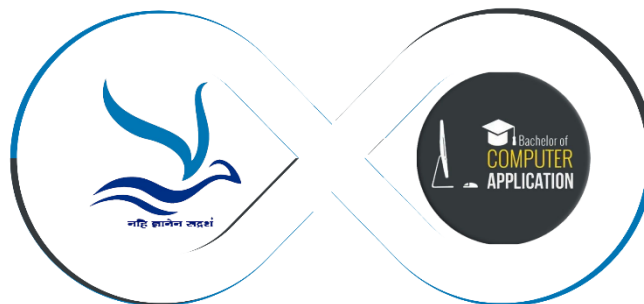
**Project Report
On
“SMART YIELD”**

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF COMPUTER APPLICATIONS (B.C.A)

**BY
INAMULLA
UUCMS NO: U16MD21S0041**

**UNDER THE GUIDANCE OF
Mrs. VINUTHA H M M. Sc, B.Ed
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**Department of Computer Science
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BALLARI**



SHREE MEDHA DEGREE COLLEGE

AFFILIATED TO VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY, BALLARI

DEPARTMENT OF COMPUTER SCIENCE

CERTIFICATE

This is to certify that **Mr. Inamulla** , bearing UUCMS No. **U16MD21S0041** , has satisfactorily completed the project entitled “**Smart Yield**” using **Python, Flask, HTML, CSS and JavaScript** technology. This project was undertaken as part of the **B.C.A. – VI Semester** course requirements prescribed by Vijayanagara Sri Krishnadevaraya University, Ballari. The project was conducted in the Computer Science laboratory of this college during August – September 2024.

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1)

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Date of examination :

DECLARATION

I hereby declare that the project report entitled “**Smart Yield**” is a result of my own work and investigation, conducted under the supervision of **Mrs. Vinutha H M, Department of Computer Science**. The work presented in this report has not been submitted to any other institution or university for the award of any degree.

I further declare that all the sources of information and data used in this report have been duly acknowledged, and the project is an original work. Any assistance or contributions from other sources have been appropriately cited.

Date:

Place:

Signature: _____

Name: **Inamulla**

UUCMS Number: **U16MD21S0041**

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I would like to extend my sincere gratitude to all those who have contributed to the successful completion of this project.

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Date:

Signature: _____

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ABSTRACT

Objectives:

The objective of the “Smart Yield” project is to enhance the accuracy of cotton yield prediction by developing and evaluating advanced regression models. The project aims to integrate key factors such as soil characteristics, weather conditions, and specific cotton parameters into linear, polynomial, and non-linear regression models. By assessing these models using performance metrics like R^2 , RMSE, and MAPE, the project seeks to provide valuable insights for farmers, agricultural planners, and stakeholders. Ultimately, the goal is to improve crop management and resource allocation, boost cotton production efficiency, and support sustainable farming practices through more accurate and reliable yield forecasts.

Methodology:

The “SmartYield” project methodology involves several key steps. Data collection includes gathering extensive datasets on cotton yield, soil characteristics, weather conditions, and cotton-specific parameters. Preprocessing ensures data quality through cleaning, normalization, and consistency checks. Feature selection identifies significant predictors impacting yield. Various regression models are developed, including linear, polynomial, and non-linear, with performance evaluated using metrics like R^2 , RMSE, and MAPE. Models are trained and validated using cross-validation techniques. The project also includes visualizations for presenting results and a user interface developed with Python for backend processing and HTML, CSS, and JavaScript for frontend interaction, enabling users to input data and obtain predictions.

Key Findings:

The implementation successfully achieved the core objectives:

- **Model Performance:** Non-linear regression models were found to be the most accurate for predicting cotton yields, surpassing both linear and polynomial models in terms of precision.
- **Key Influences:** Factors such as soil moisture, temperature, and cotton variety were identified as significant predictors of cotton yield, highlighting their importance in the forecasting process.

- **Data and Feature Selection:** The project emphasized the necessity of high-quality data and proper feature selection to enhance model performance and accuracy.
- **Decision-Making Support:** The improved predictive accuracy provides valuable insights for farmers and stakeholders, aiding in more informed decisions about crop management and resource allocation.
- **Sustainability and Efficiency:** Accurate yield predictions contribute to optimizing resource use and support sustainable farming practices, ultimately enhancing the efficiency of cotton production.

Conclusion:

The “SmartYield” project has proven that non-linear regression models offer the most accurate predictions for cotton yields, outperforming traditional linear and polynomial models. By incorporating critical factors such as soil moisture, temperature, and cotton variety, the project underscored their significant impact on yield forecasting. The emphasis on high-quality data and thorough feature selection was crucial for achieving model accuracy. These advancements enable farmers and stakeholders to make more informed decisions, leading to improved crop management and resource allocation. Ultimately, the project supports more efficient and sustainable cotton production, benefiting both economic and environmental aspects of the industry.

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1. INTRODUCTION

Agriculture is a fundamental sector that underpins global food security and economic stability. With the increasing challenges posed by climate change, soil degradation, and market fluctuations, there is a growing need for advanced tools to enhance agricultural productivity and sustainability. Predictive modeling, powered by big data analytics, has emerged as a critical tool in addressing these challenges by providing valuable insights and forecasts that inform decision-making processes.

Among various crops, cotton holds significant economic value due to its widespread use in the textile industry. Accurate prediction of cotton yield is essential for optimizing crop management, improving resource allocation, and maximizing economic returns for farmers and agricultural stakeholders. Traditional methods of yield prediction often fall short due to their reliance on limited data and simplistic models. However, the integration of predictive modeling techniques offers a more nuanced and accurate approach to forecasting cotton yields.

This project “**SmartYield**” aims to develop and evaluate regression models for predicting cotton yield based on a range of factors including soil characteristics, weather conditions, and specific cotton parameters. By comparing various regression models, such as linear, polynomial, and non-linear regression, the research seeks to identify the most accurate and reliable model for predicting cotton yields. Key performance metrics, including R^2 (R-squared), RMSE (Root Mean Squared Error), and MAPE (Mean Absolute Percentage Error), will be used to assess the effectiveness of these models.

The outcomes of this research are expected to provide valuable insights for farmers, agricultural planners, and industry stakeholders. By leveraging advanced predictive models, stakeholders can make informed decisions that enhance crop management practices, optimize resource use, and ultimately improve cotton production efficiency. This, in turn, can contribute to better economic outcomes and support the sustainability of cotton farming practices.

1.1 Background Information on the Project

Predictive modeling is an advanced statistical technique used to forecast future outcomes based on historical data. In recent years, the advent of big data has significantly transformed predictive modeling by providing vast amounts of information that can be analyzed to generate insights and predictions. The rise of big data analytics has enabled the development of sophisticated models that can handle complex datasets and uncover patterns that might not be apparent from smaller datasets.

In the agricultural sector, predictive models play a crucial role in optimizing crop production and ensuring food security. These models can predict various aspects of crop growth, such as yield, based on multiple factors, including weather conditions, soil quality, and crop management practices. For farmers and agricultural industries, accurate yield predictions are essential for making informed decisions regarding planting, resource allocation, and market strategies.

Agricultural systems are inherently complex due to the numerous variables involved, such as soil characteristics, weather conditions, and crop management practices. These factors interact in intricate ways, making it challenging to predict outcomes accurately. The integration of big data into agricultural predictive modeling helps address this complexity by providing a comprehensive view of the factors influencing crop yields.

Cotton is a major cash crop with significant economic importance. Accurate prediction of cotton yield is vital for farmers to plan their production and for industries to manage supply chains effectively. Cotton yield prediction involves analyzing various parameters, such as soil quality, weather patterns, and cotton-specific growth characteristics.

Regression models are commonly used in predictive analytics to estimate the relationship between a dependent variable (e.g., cotton yield) and one or more independent variables (e.g., soil properties, weather conditions). Several types of regression models can be employed for this purpose, including:

- **Linear Regression:** Assumes a linear relationship between dependent and independent variables.
- **Polynomial Regression:** Allows for more complex relationships by using polynomial terms.
- **Multiple Regression:** Involves multiple predictors to provide a more nuanced prediction.
- **Non-linear Regression:** Handles non-linear relationships between variables.

To assess the performance of regression models, various metrics are used:

- **R² (R-squared):** Indicates the proportion of variance in the dependent variable that is predictable from the independent variables. A higher R² value signifies a better model fit.
- **RMSE (Root Mean Squared Error):** Measures the average magnitude of the errors between predicted and observed values. Lower RMSE values indicate better predictive accuracy.
- **MAPE (Mean Absolute Percentage Error):** Provides a percentage measure of prediction accuracy, allowing for easy interpretation of model performance.

In the context of cotton yield prediction, comparing different regression models helps identify the most accurate and reliable model for forecasting. By evaluating models based on metrics such as R², RMSE, and MAPE, researchers can select the best-performing model for practical applications in agriculture.

The application of predictive modeling in agriculture, particularly for cotton yield prediction, leverages big data to improve decision-making processes and enhance productivity. By employing and comparing various regression models, researchers and practitioners can develop more accurate and effective tools for forecasting crop yields, ultimately benefiting farmers and the agricultural industry as a whole.

1.2 Objectives and Scope of the Project

Objectives:

➤ **Develop Predictive Models for Cotton Yield**

Create and refine various regression models to predict cotton yield based on multiple influencing factors. Models to be developed will include linear regression, polynomial regression, multiple regression, and non-linear regression. Each model will be designed to analyze the relationships between cotton yield and input variables such as soil properties, weather conditions, and cotton-specific parameters.

➤ **Incorporate and Analyze Multiple Factors**

Integrate a comprehensive set of factors affecting cotton yield into the predictive models. Key factors include soil characteristics (e.g., moisture, nutrient levels, pH), weather conditions (e.g., temperature, precipitation, humidity), and cotton parameters (e.g., plant growth stage, variety). The aim is to evaluate how these variables interact and impact cotton yield.

➤ **Evaluate Model Performance**

Assess the accuracy and reliability of the developed regression models using established performance metrics. Utilize metrics such as R^2 (R-squared), RMSE (Root Mean Squared Error), and MAPE (Mean Absolute Percentage Error) to compare the performance of different models. The goal is to identify the model that best predicts cotton yield with the highest accuracy.

➤ **Compare Regression Models**

Conduct a comparative analysis of the different regression models to determine their effectiveness in predicting cotton yield. Compare the models based on their predictive performance metrics to understand which model provides the most accurate and reliable

forecasts. This comparison will help in selecting the best model for practical application in cotton yield prediction.

➤ **Provide Actionable Insights for Stakeholders**

Generate actionable insights and recommendations based on the findings from the predictive models. Translate the results into practical recommendations for farmers, agricultural planners, and industry stakeholders. This includes guidelines on optimizing cotton production practices, resource allocation, and yield management based on the predictive model outputs.

➤ **Contribute to Agricultural Research and Practices**

Enhance the understanding of predictive modeling applications in agriculture and contribute to ongoing research efforts. Document the methodologies, findings, and insights from the project to support further research and development in agricultural predictive modeling. Share the results with the academic community and industry practitioners to advance knowledge and practice in the field.

➤ **Explore Potential for Automation**

Investigate the feasibility of automating the yield prediction process based on the developed models. Assess how the predictive models can be integrated into automated systems for real-time yield predictions and decision-making support. Explore potential technologies and platforms for implementing automated predictive tools in agricultural practices.

Scope:

➤ **Geographic and Temporal Scope**

The project will focus on cotton yield prediction within a specified region or set of regions where cotton farming is prevalent. This could be a particular country, state, or agricultural zone known for cotton cultivation. The analysis will cover historical data from a defined period, which could range from a few years to several decades, depending on data availability. The predictive models will be developed and validated based on this historical dataset.

➤ **Data Collection and Integration**

The project will utilize various data sources, including soil quality measurements, weather data (temperature, precipitation, humidity), and cotton growth parameters (variety, planting date, growth stages). Data may be sourced from agricultural databases, weather stations, and field surveys. The project will involve integrating these diverse data sources into a cohesive dataset for analysis. This will include data cleaning, preprocessing, and feature selection to ensure the quality and relevance of the input variables.

➤ **Predictive Modeling**

The project will develop and compare several regression models, including linear regression, polynomial regression, multiple regression, and non-linear regression, to predict cotton yield. The models will be tailored to handle the specific complexities of cotton yield prediction. Models will be trained on historical data and validated using appropriate validation techniques, such as cross-validation or train-test splits, to assess their predictive performance.

➤ **Performance Evaluation**

The project will use performance metrics such as R^2 (R-squared), RMSE (Root Mean Squared Error), and MAPE (Mean Absolute Percentage Error) to evaluate and compare the effectiveness of the different regression models. The models will be benchmarked against each other to determine which provides the most accurate and reliable predictions of cotton yield.

➤ **Practical Applications and Recommendations**

The project will provide practical recommendations for farmers and agricultural stakeholders based on the predictive model results. This includes guidelines for optimizing cotton production practices and resource allocation. The feasibility of automating the yield prediction process will be explored, with a focus on integrating the predictive models into real-time decision-making systems.

➤ **Documentation and Reporting**

Detailed documentation of the methodologies, data sources, model development, and evaluation processes will be provided. This will include technical reports, research papers, and presentation materials. The project will include efforts to communicate findings and recommendations to stakeholders through reports, presentations, and potentially workshops or seminars.

➤ **Future Work and Research**

The project will identify potential areas for future research, including improvements to the models, exploration of additional data sources, and extension to other crops or regions. Consideration will be given to the scalability of the predictive models for application in other agricultural contexts or with different crop types.

1.3. Minimum Software Requirements

➤ **Operating System:**

- Windows 10 or later: The operating system where your development environment will run. Windows 10 or later versions are recommended due to their support for modern software and security updates.

➤ **Server:**

- Recommended: Latest stable versions of Windows Server (e.g., Windows Server 2022), Ubuntu Server, or CentOS for enterprise-level deployments.
- Minimum: Windows Server 2016, Ubuntu 20.04 LTS, or CentOS 7.

➤ **Client:**

- Recommended: Windows 10 or later, macOS 11 or later, or a recent Linux distribution (e.g., Ubuntu 22.04 LTS).
- Minimum: Windows 7, macOS 10.14, or Ubuntu 18.04 LTS.

➤ **Web Browser:**

- Recommended: Latest versions of Google Chrome, Mozilla Firefox, Microsoft Edge, or Safari. These browsers offer the best compatibility with modern web standards and security features.
- Minimum Support for recent major versions of these browsers. For instance, Google Chrome 90+, Firefox 85+, Edge 90+, and Safari 14+.

➤ **IDE/Code Editor:**

- Visual Studio Code (with PHP extensions): A popular code editor with support for various programming languages and extensions. PHP extensions in VS Code provide syntax highlighting, debugging, and other features specific to PHP development.

➤ **Database Management System (DBMS):**

- MySQL 5.7 or later, or MariaDB 10.2 or later: Databases used to store and manage application data. MySQL and MariaDB are compatible, and newer versions offer enhanced features, performance, and security.

Frontend : HTML,CSS,JS

Backend : Python,flask

Database: Mysql,NoSql

1.4.Minimum Hardware Requirements

➤ Processor for Development Machine:

- Intel Core i3 (8th Generation) or AMD Ryzen 3 provides sufficient processing power for running development tools and multitasking without significant lag.
- Web/Database Server: Intel Xeon E3-1220 v5 or equivalent is ideal for handling web server workloads, offering reliable performance for hosting and database management.

➤ RAM:

- Development Machine: 8 GB RAM ensures smooth operation of development environments, multiple applications, and virtual machines, if needed.
- Web/Database Server: 4 GB RAM is adequate for handling moderate web traffic and database queries efficiently.

➤ Storage:

- Development Machine: 250 GB SSD offers fast data access and sufficient storage space for project files and development tools.
- Web/Database Server: 100 GB SSD provides high-speed storage, improving server response times and data retrieval.

➤ Network:

- Development Machine: Ethernet or Wi-Fi connection ensures reliable internet access crucial for cloud services, version control, and collaboration tools.
- Web/Database server: 1 Gbps Ethernet connection supports high-speed data transfer, essential for serving web pages and handling requests efficiently.

➤ Graphics card:

- Development Machine: Integrated Graphics (e.g., Intel UHD Graphics or AMD Radeon Vega) are sufficient for most development tasks unless specialized graphics processing is required.

➤ Display Resolution:

- Development Machine: 1366x768 resolution provides clear visibility for coding, designing, and multitasking, though higher resolutions are preferable for enhanced clarity.

➤ Hardware Compatibility:

- Ensuring all components are compatible with each other, especially motherboard compatibility with the processor, RAM, and storage, is crucial for system stability and performance.

➤ Peripheral Devices:

- Include essential peripherals like a keyboard, mouse, and external storage for backups. A UPS (Uninterruptible Power Supply) is recommended to prevent data loss during power outages.

➤ Operating System Support:

- Ensure the chosen operating system (e.g., Windows 10, Linux) supports all hardware components and is compatible with the development and server software being used.

➤ Backup and Security:

- External backup storage (HDD/SSD or cloud) should be regularly used for backups, and appropriate security measures (e.g., firewalls, antivirus) should be in place to protect development and server environments.

2. METHODOLOGY

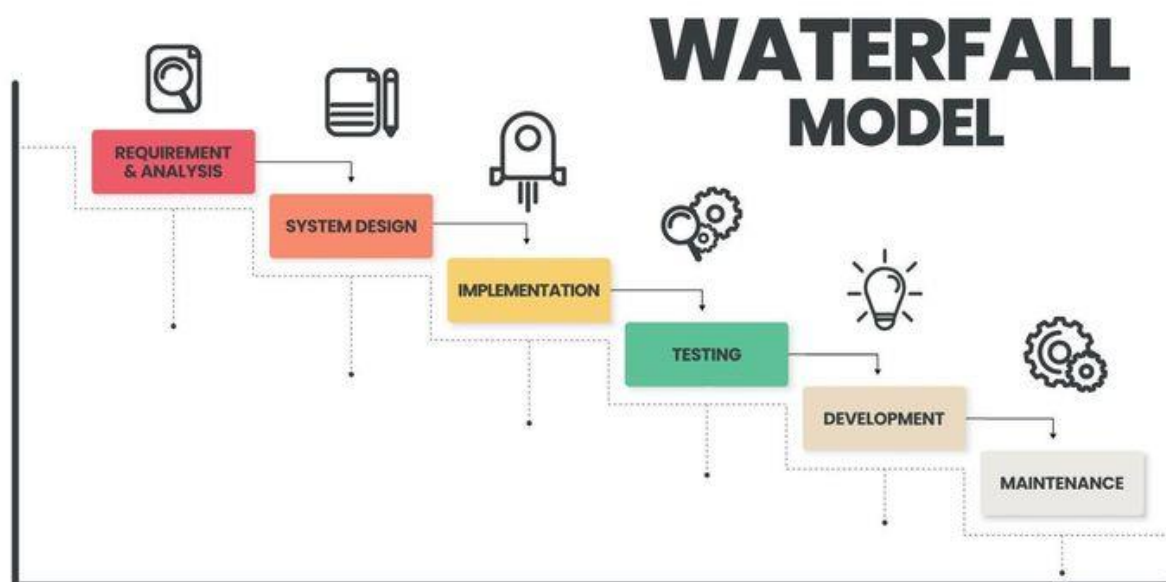
2.1 Methodologies:

Waterfall Model

The Waterfall model is a linear and sequential approach to software development that is one of the earliest models used in project management and system development. It is called "Waterfall" because the process flows in one direction, like a waterfall, through a series of distinct phases. Each phase must be completed before the next one begins, and there is typically no overlapping or iteration between phases.

the Waterfall model is a traditional and structured approach to software development that works best when the project requirements are clear, the scope is fixed, and the project is relatively simple. However, its lack of flexibility makes it less suited to projects where requirements might change or evolve during the development process. This makes the Waterfall model most suitable for smaller projects with fixed scopes and environments where thorough documentation and a disciplined approach are crucial.

The phases are Requirement, Design, Coding and Implementation, Testing, Deployment and Maintenance. This is a very old model and the drawback is even if slight changes need to be done it has to be started from the beginning.

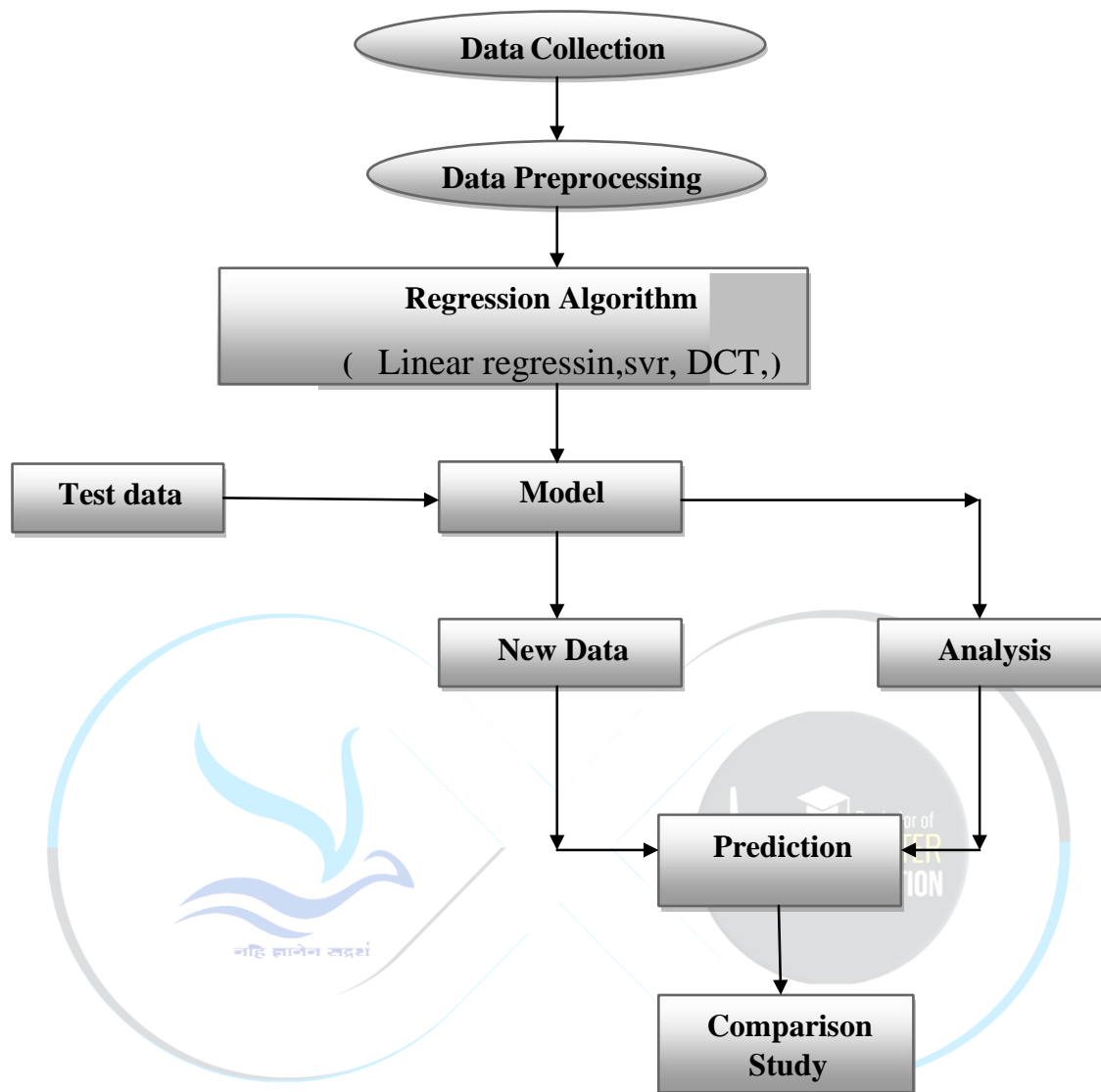


1.Requirements

Functional Requirements

A functional requirement defines a function of a system or its component. A role is described as a set of inputs, behavior, and outputs. Functional requirements may be calculations, technical details, data manipulation, and processing.

- User Management:
 - User registration, login, and profile management.
 - Password encryption and authentication.
- The Methods of the system are as follows.
 - **Data preprocessing:** Dataset will be added to the preprocessing.
 - a) **Input:** cotton dataset.
 - b) **Process:** Preprocessing will find missing value and also does feature remove.
 - c) **Output:** preprocessed dataset.
 - d) **Error handling:** If the input file is not a valid one.
 - **Feature selection:** Selection of the data from a dataset.
 - a) **Input:** preprocessed dataset.
 - b) **Process:** It will select only important data which is required.
 - c) **Output:** Selected data will be displayed.
 - **Splitting of the Data:** Training data and Test Data.
 - a) **Input:** Feature selected data.
 - b) **Process:** It will split the data into the train set and test set.
 - c) **Output:** Dataset will be displayed as Train set and Test set and it will be tested for the specific algorithms and performance analysis will be carried out.

FUNCTIONAL REQUIREMENTS:

The product consists of a model that functions based on

- Collecting Data The data is collected from previous Cotton yield records in Kaggle datasets.
- 2. Then pre-processing the data pre-processing is adding the data.
- 3. Performing data mining algorithms The data mining algorithms include (svm classifier,KNN, svr).
- 4.The algorithm helps in predicting the result based on the parameters
- 5. The analysis help in the prediction of Disease

Product Functions

1. Uploading Data Uploading data sets.
2. Perform Prediction is done by each algorithm based on the constraints.
 - 4. Comparison Study Prediction results and its stages of each algorithm is represented through graph.

2. Design

Architectural Design

- Frontend:
 - Design user interfaces (UI) using HTML, CSS, and JavaScript.
 - Responsive design to support various devices (desktop, tablet).
- Backend:
 - Python and flask framework.
 - Design database schema and relationships.
- Database:
 - Design tables and relationships for user data, courses, assessments, certifications, etc.
- Security:
 - Implement secure authentication and authorization mechanisms.
 - Design encryption methods for sensitive data.

3. Implementation

Frontend Development

- HTML: Create structured pages for user interactions, including login and registration forms, club and event listings, and user profile pages.
- CSS: Style the application for a polished look. Ensure responsiveness across different devices using CSS media queries or frameworks like Bootstrap.
- JavaScript: Enhance functionality with interactive elements like form validations, dynamic content updates via AJAX, and real-time notifications.

Backend Development

- Python (Flask):
 - **Model Training and Evaluation:**
 - **Scripts to Manage Models:** Implement scripts to train and evaluate regression models for yield prediction.
 - **Model Serialization:** Save and load trained models for predictions.
 - **API Development:**
 - **Prediction Endpoints:** Scripts to handle incoming requests for yield predictions.

- **Data Processing:** Scripts to preprocess and format incoming data for predictions.
- **Form Processing:**
 - **Input Validation:** Handle and validate user inputs for predictions.
- **SQLite (or other relational database):**
 - **Database Design:**
 - **Tables and Schema:** Define tables for storing historical data, model parameters, and prediction results.
 - **Relationships and Indexes:** Establish relationships between tables and create indexes for efficient querying.
 - **Queries:**
 - **Data Retrieval:** Scripts to query historical data for training and analysis.
 - **Data Management:** Scripts to insert, update, and delete records as needed.
 - **Security:**
 - **Data Validation:** Ensure all incoming data is validated and sanitized.
 - **Error Handling:** Implement robust error handling to manage potential issues gracefully.

4. Testing

Unit Testing

- Frontend Tests:
 - Test individual components and functions.
- Backend Tests:
 - Test API endpoints and business logic.

Integration Testing

- End-to-End Testing:
 - Test complete user flows from registration to certification.
- Database Testing:
 - Ensure data is correctly stored and retrieved.

Performance Testing

- Load Testing:
 - Test application performance under load.
- Stress Testing:
 - Assess application stability under extreme conditions.

Security Testing

- Vulnerability Scanning:
 - Scan for common security vulnerabilities.
- Penetration Testing:
 - Conduct penetration tests to identify potential security issues.

5. Deploying

Deployment Strategy

- Environment Setup:
 - Set up production environment (servers, databases, etc.).
- Continuous Integration/Continuous Deployment (CI/CD):
 - Implement CI/CD pipelines for automated testing and deployment.
- Version Control:
 - Use version control (e.g., Git) for code management.
- Serverless:
 - AWS Lambda, Google Cloud Functions (event-driven).
- Monitoring:
 - Set up monitoring for application performance and errors.

6. Maintenance

- Monitoring and Performance Tuning
 - Application Monitoring:
 - Implement logging and monitoring tools (e.g., New Relic, Datadog, Prometheus) to track application performance and errors.
 - Regularly review logs for issues and performance bottlenecks.
 - Performance Optimization:
 - Optimize code and queries to improve response times and reduce latency.
 - Scale resources based on traffic and performance metrics.
 - Database Maintenance:
 - Monitor database performance and optimize queries and indexes.
 - Perform regular backups and restore testing to ensure data integrity.
- Security Management
 - Vulnerability Scanning:
 - Regularly scan for vulnerabilities in the application and its dependencies (e.g., using tools like Snyk or OWASP Dependency-Check).
 - Apply security patches and updates promptly.
 - Access Control:

- Review and manage user access and permissions to ensure proper authorization.
 - Update credentials and access keys periodically.
- Data Protection:
 - Implement encryption for sensitive data both in transit and at rest.
 - Ensure compliance with data protection regulations (e.g., GDPR, CCPA).
- Bug Fixes and Updates
 - Bug Tracking:
 - Use a bug tracking system (e.g., Jira, GitHub Issues) to manage and prioritize bug reports and feature requests.
 - Regular Updates:
 - Update dependencies and libraries to their latest versions to incorporate security fixes and performance improvements.
 - Address and fix bugs and issues as they arise.
- Feature Enhancements
 - Feature Requests:
 - Review and prioritize new features based on user feedback and business needs.
 - Development and Testing:
 - Develop new features and improvements in a staging environment before deploying to production.
 - Perform thorough testing to ensure new features do not introduce regressions.
- Deployment Management
 - CI/CD Pipeline Maintenance:
 - Ensure that the CI/CD pipelines are functioning correctly and address any issues.
 - Update deployment scripts and configuration files as needed.
 - Rollback Procedures:
 - Maintain and test rollback procedures to quickly revert changes if issues arise during deployment.
- User Support and Feedback
 - User Support:
 - Provide ongoing support to users through help desks, support tickets, or chat systems.
 - Address user queries and issues in a timely manner.
 - Feedback Collection:
 - Collect and analyze user feedback to identify areas for improvement and new feature opportunities.

➤ **Backup and Disaster Recovery**

- **Regular Backups:**
 - Schedule and perform regular backups of application data, configurations, and code.
 - Test backup and restore procedures periodically to ensure data can be recovered in case of failure.
- **Disaster Recovery Planning:**
 - Develop and maintain a disaster recovery plan to handle potential outages or major failures.

SDLC(Software development lifecycle)

The Software Development Life Cycle (SDLC) is a systematic process used by software developers to plan, design, develop, test, and deploy software applications. It serves as a framework that guides the development process, ensuring that the software is built efficiently, meets user requirements, and is of high quality. The SDLC typically involves several phases:

➤ **Planning:**

- **Objective:** Define the project scope, objectives, and feasibility. Gather initial requirements and create a project plan.
- **Activities:** Stakeholder meetings, feasibility studies, resource planning, and cost estimation.
- **Outcome:** A detailed project plan, including timelines, budget, and resources.

➤ **Requirements Gathering and Analysis:**

- **Objective:** Understand and document the exact requirements of the system from the stakeholders.
- **Activities:** Interviews, questionnaires, workshops, and reviewing existing systems. Analyze and prioritize the requirements.
- **Outcome:** A detailed requirement specification document, outlining what the system should do.

➤ **Design:**

- **Objective:** Create the architecture of the software, detailing how the system will meet the requirements.
- **Activities:** System design, including data flow diagrams, system architecture, database design, and interface design.

- Outcome: Design documents and system models that serve as blueprints for the development phase.

➤ **Development:**

- Objective: Write the code to create the software as per the design specifications.
- Activities: Coding by developers, unit testing, and integration of different modules.
- Outcome: Functional software that meets the design specifications.

➤ **Testing:**

- Objective: Identify and fix any defects or issues in the software before deployment.
- Activities: System testing, integration testing, user acceptance testing, and bug fixing.
- Outcome: A tested software product that is ready for deployment, ensuring it meets quality standards and requirements.

➤ **Deployment:**

- Objective: Deliver the software to the users and make it available for use.
- Activities: Deployment to production servers, installation, and configuration. Sometimes includes training for users.
- Outcome: The software is live and accessible to users in the production environment.

➤ **Maintenance:**

- Objective: Ensure the software continues to function correctly after deployment and make updates as needed.
- Activities: Bug fixing, updates, enhancements, performance monitoring, and ongoing support.
- Outcome: A stable software product that continues to meet user needs and adapts to any necessary changes.

Features of the SDLC Waterfall Model

1. Sequential Approach: The waterfall model involves a sequential approach to software development, where each phase of the project is completed before moving on to the next one.
2. Document-Driven: The waterfall model relies heavily on documentation to ensure that the project is well-defined and the project team is working towards a clear set of goals.
3. Quality Control: The waterfall model places a high emphasis on quality control and testing at each phase of the project, to ensure that the final product meets the requirements and expectations of the stakeholders.
4. Rigorous Planning: The waterfall model involves a rigorous planning process, where the project scope, timelines, and deliverables are carefully defined and monitored throughout the project lifecycle.

Overall, the waterfall model is used in situations where there is a need for a highly structured and systematic approach to software development. It can be effective in ensuring that large, complex projects are completed on time and within budget, with a high level of quality and customer satisfaction.

Importance of SDLC Waterfall Model

1. **Clarity and Simplicity:** The linear form of the Waterfall Model offers a simple and unambiguous foundation for project development.
2. **Clearly Defined Phases:** The Waterfall Model's phases each have unique inputs and outputs, guaranteeing a planned development with obvious checkpoints.
3. **Documentation:** A focus on thorough documentation helps with software comprehension, upkeep, and future growth.
4. **Stability in Requirements:** Suitable for projects when the requirements are clear and steady, reducing modifications as the project progresses.
5. **Resource Optimization:** It encourages effective task-focused work without continuously changing contexts by allocating resources according to project phases.
6. **Relevance for Small Projects:** Economical for modest projects with simple specifications and minimal complexity.

Advantages of the SDLC Waterfall Model:

The classical waterfall model is an idealistic model for software development. It is very simple, so it can be considered the basis for other software development life cycle models. Below are some of the major advantages of this SDLC model.

- **Easy to Understand:** The Classical Waterfall Model is very simple and easy to understand.
- **Individual Processing:** Phases in the Classical Waterfall model are processed one at a time.
- **Properly Defined:** In the classical waterfall model, each stage in the model is clearly defined.
- **Clear Milestones:** The classical Waterfall model has very clear and well-understood milestones.
- **Properly Documented:** Processes, actions, and results are very well documented.
- **Reinforces Good Habits:** The Classical Waterfall Model reinforces good habits like define-before-design and design-before-code.
- **Working:** Classical Waterfall Model works well for smaller projects and projects where requirements are well understood.

2.2 Technologies

Frameworks and Libraries:

FLASK:

Flask is a lightweight and flexible web framework for Python, designed to make it easy to build web applications and APIs. It is known for its simplicity and minimalism, offering core features while allowing developers to choose additional components and libraries based on their needs. Flask follows the WSGI (Web Server Gateway Interface) standard, which ensures compatibility with various web servers.

Flask is often chosen for its balance between simplicity and power. It allows developers to start with a basic structure and gradually add features as the project evolves. One of the key advantages of Flask is its modularity. Developers can pick and choose the components they need without being forced into a specific project layout or bundled features, which is common in more monolithic frameworks. Flask applications are built around routes, which are essentially the URLs that the application responds to. These routes are tied to functions, often referred to as "view functions," which handle the logic for what happens when a user visits a particular page. Flask's routing system is highly flexible, allowing developers to create RESTful APIs and complex web applications with ease.

Another significant feature of Flask is its support for Jinja2 templating. This enables developers to create dynamic HTML pages by embedding Python expressions within the HTML code. The templating system is powerful yet intuitive, allowing for reusable components and layouts that can significantly speed up development time.

Flask also excels in handling HTTP requests and responses, making it easy to work with forms, cookies, and sessions. Additionally, it supports JSON out of the box, which is particularly useful for API development. Flask's built-in development server provides a quick way to test applications locally, with features like hot reloading that automatically refresh the application as code changes are made.

Python:

Python is a deciphered, significant level, broadly useful programming language. Made by Guido van Rossum and first delivered in 1991, Python's plan reasoning accentuates code meaningfulness with its prominent utilization of critical whitespace. Its language develops and object-arranged methodology plan to assist software engineers with composing clear, consistent code for little and huge scope ventures.

Python is progressively composed and trash gathered. It underpins numerous programming standards, including procedural, object-arranged, and practical programming. Python is frequently portrayed as a "batteries included" language because of its thorough standard library. Python is a multi-worldview programming language. Article arranged programming and organized writing computer programs are completely upheld, and a significant number of its highlights uphold useful programming and angle situated programming (counting by metaprogramming and metaobjects (enchantment methods)).] Many different standards are upheld by means of expansions, including plan by agreement and rationale programming.

Numpy:

NumPy is the principal bundle for logical registering with Python. It contains in addition to other things: An amazing N-dimensional cluster object, Sophisticated (broadcasting) capacities, Tools for incorporating C/C++ and Fortran code, Useful straight polynomial math, Fourier change, and arbitrary number abilities.

Pandas:

pandas is an open source, BSD-authorized library giving elite, simple to-utilize information structures and information investigation apparatuses for the Python programming language. pandas is a Num FOCUS supported undertaking. This will help guarantee the achievement of improvement of pandas as an a-list open-source venture, and makes it conceivable to give to the task.

2.3 Tools

➤ **Development Tools:**

IDE:

- Visual Studio Code (VS Code): Visual Studio Code is a versatile and highly customizable code editor that supports a wide range of programming languages, including PHP, HTML, CSS, and JavaScript. Its extensive ecosystem of extensions enhances functionality and supports various workflows. Visual Studio Code (VS Code) was selected as the primary Integrated Development Environment (IDE) for the development of the Spotify Analytics Dashboard. VS Code is a widely-used, opensource IDE developed by Microsoft that is known for its lightweight and highly customizable nature. It offers a plethora of extensions and integrations that make it suitable for various programming languages and frameworks.

- Visual Studio Code (VS Code) is a highly versatile, open-source code editor developed by Microsoft. It is widely acclaimed for its powerful features and user-friendly interface, making it a popular choice among developers and data scientists.
- VS Code supports a vast array of programming languages and frameworks, including Python, JavaScript, TypeScript, and more, through its extensive library of extensions. Its built-in features include syntax highlighting, code completion, and IntelliSense, which provide intelligent code suggestions and error checking, enhancing coding efficiency and accuracy.

➤ **Flask Framework**

- Flask is a miniature web system written in Python. It is delegated a microframework in light of the fact that it doesn't need specific apparatuses or libraries.[3] It has no information base deliberation layer, structure approval, or whatever other segments where prior outsider libraries give normal capacities. In any case, Flask upholds augmentations that can include application includes as though they were executed in Flask itself. Augmentations exist for object-social mappers, structure approval, transfer dealing with, different open confirmation advancements and a few basic system related devices. Augmentations are refreshed unmistakably more as often as possible than the center Flask program. Flask is the core web framework being used here. It's responsible for managing routing (e.g., /, /signup, /login, etc.), handling HTTP requests (GET, POST) and rendering HTML templates, managing sessions, user login/logout.

➤ **Flask Extensions:**

Flask-SQLAlchemy:

- ORM (Object Relational Mapping) for database interactions. Tables like User, Candidate, Register, etc., are modeled as classes.

Flask-Login:

- Used for handling user authentication, managing user sessions, and protecting routes (e.g., requiring login for certain pages).

Flask-WTF:

- For handling CSRF protection (generate_csrf()).

➤ **File Handling & Storage**

Werkzeug utilities like secure_filename are used for securely handling file uploads.

Uploaded files like resumes, certificates, and pictures are saved in organized directories (static/Files/).

➤ **Frontend Tools**

HTML Templates: Flask's `render_template()` is used to serve dynamic HTML pages, making use of variables and data passed from Python.

CSRF Tokens: For protecting forms from CSRF attacks (`generate_csrf()`).



3. IMPLEMENTATION

3.1. Detailed Explanation of the Project Development Process (UML diagrams)

The project development process is a structured approach to creating, executing, and completing a project. Developing the "SmartYield" project involves several stages, each with its own set of tasks and objectives. To provide a comprehensive overview, we'll break down the development process into detailed steps and use UML (Unified Modeling Language) diagrams to illustrate the design and structure of the application.

1. Project Planning

Objective: Define project goals, requirements, and scope.

- **Tasks:**
 - Identify stakeholders and gather requirements.
 - Define project goals and objectives.
 - Plan the project timeline and milestones.

2. System Design

Objective: Design the system architecture, components, and interactions.

- **Tasks:**
 - Define the architecture and technology stack.
 - Design the data model and database schema.
 - Plan the application's user interface (UI) and user experience (UX).
 - Architecture Design:
 - Backend: Choose PHP as the server-side language and MySQL as the database. Design the server architecture, including server setup, API endpoints, and data flow.
 - Frontend: Plan the user interface using HTML, CSS, and JavaScript. Decide on the layout, navigation, and user interaction elements.
 - Data Model: Design the database schema, including tables, relationships, and constraints. Define how data will be stored and accessed.
 - User Interface Design:
 - Wireframes: Create wireframes or mockups for the application's pages and components.
 - Prototypes: Develop interactive prototypes to visualize the user experience and gather feedback.

- **Development**

Objective: Implement the design by coding the application

- Frontend Development:
 - HTML/CSS: Build the static structure and styling of web pages.
 - JavaScript: Implement dynamic functionality, such as form validation, AJAX calls, and user interactions.
- **Deployment**


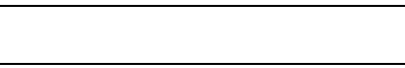

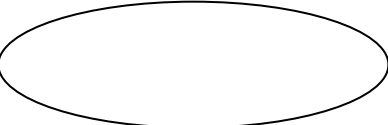
Objective: Deploy the application to a production environment.

 - **Tasks:**
 - Prepare Deployment Environment: Set up servers, databases, and other infrastructure.
 - Deploy Application: Use tools like Docker, Gunicorn, and Nginx for deployment.
 - Monitor and Maintain: Track performance and address any issues.

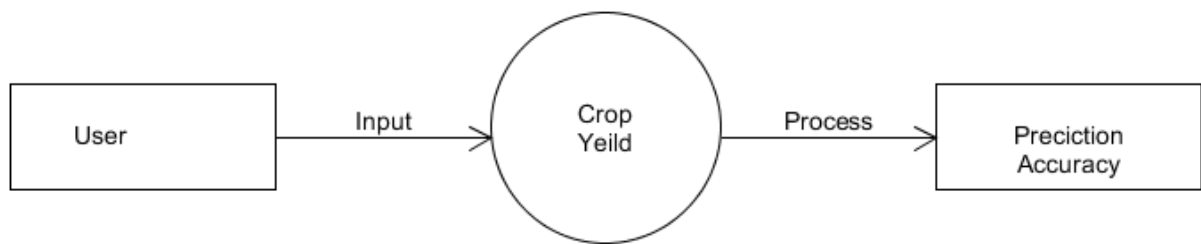
3.1 UML Diagrams

DFD:

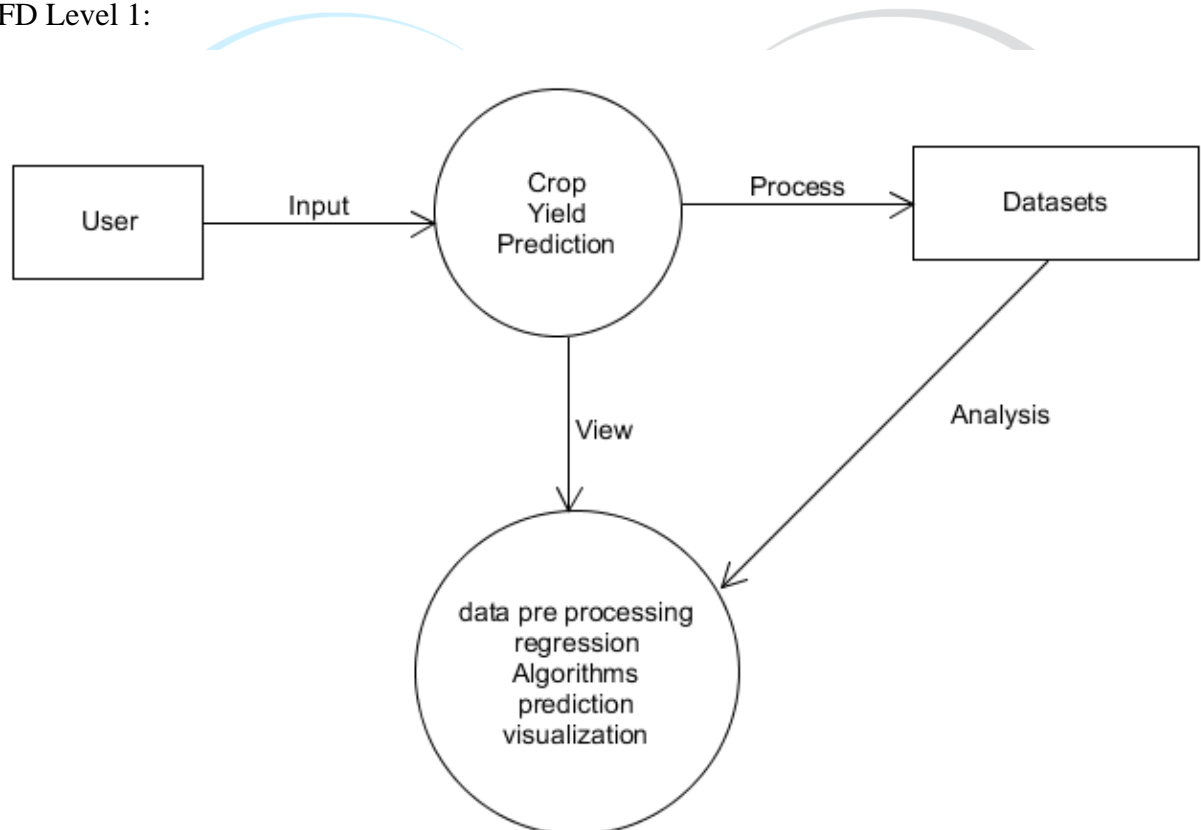
A Data Flow Diagram (DFD) is a graphical portrayal of the "stream" of information through an Information System. An information stream outline can likewise be utilized for the representation of Data Processing. It is normal practice for a creator to draw a setting level DFD first which shows the cooperation between the framework and outside elements. This setting level DFD is then "detonated" to show more detail of the framework being displayed.

SYMBOLS	DESCRIPTION
	Represents Data Flow
	Represents Database
	Represents the External Entity
	Represents the Process that transforms incoming data flows into outgoing data flow.

DFD Level 0:



DFD Level 1:

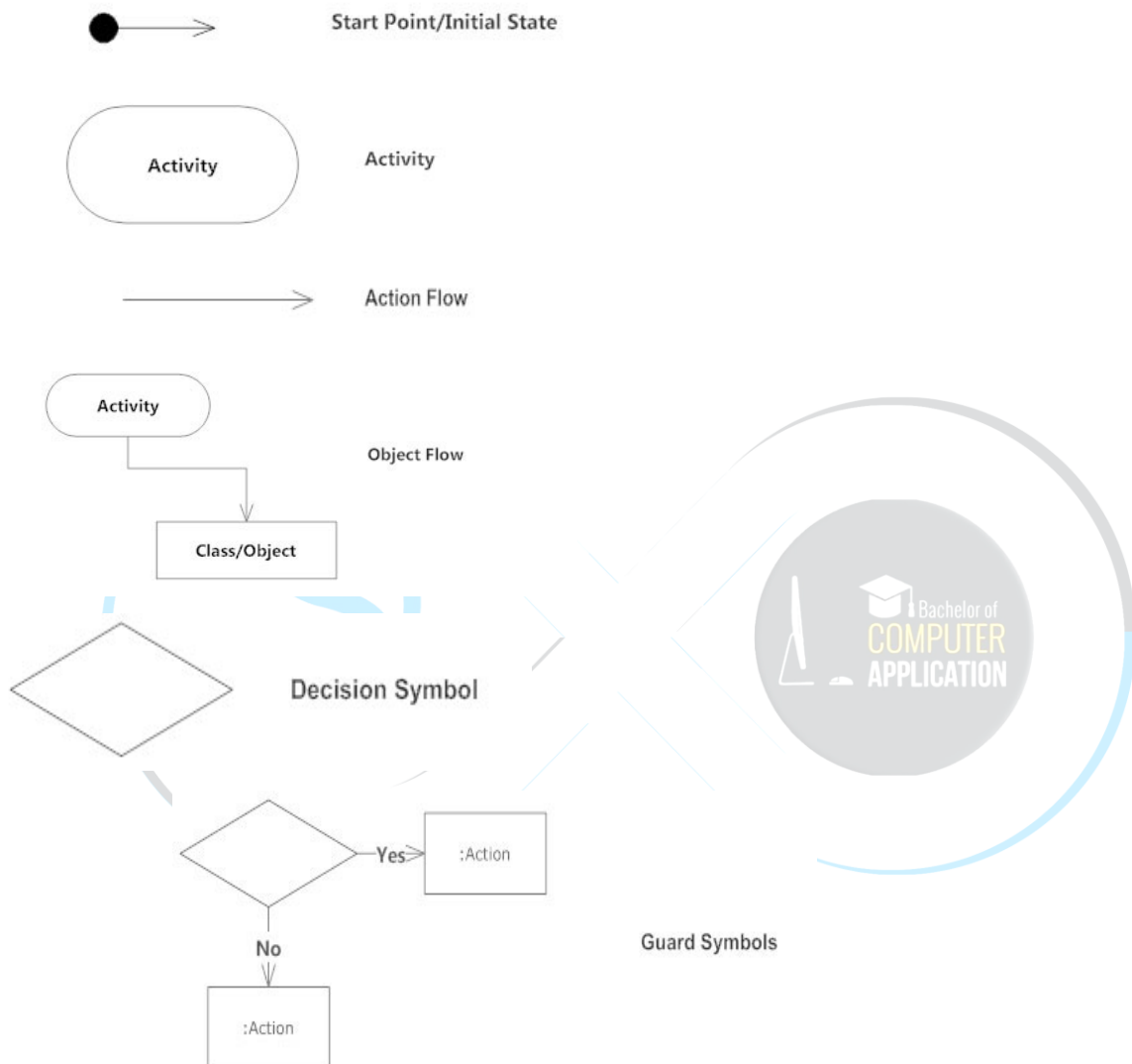


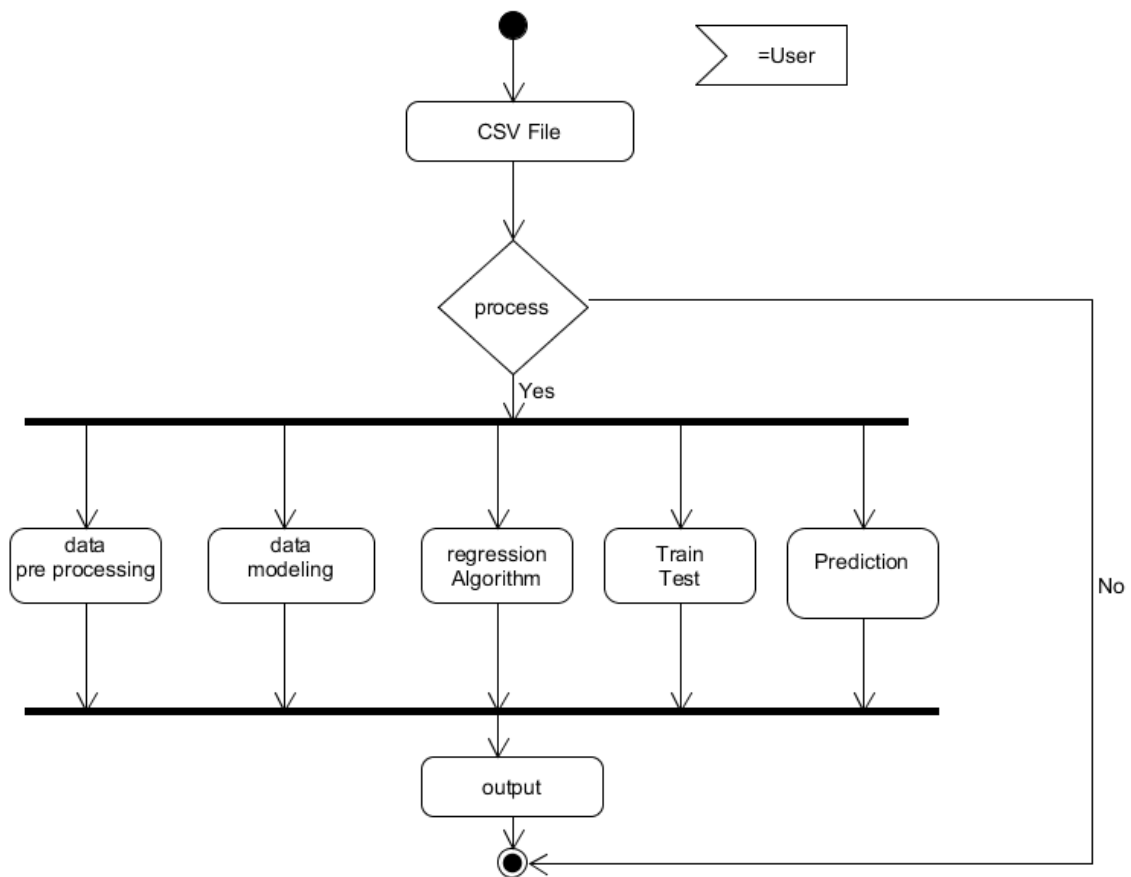
Activity Diagram:

An activity diagram outwardly presents a progression of activities or stream of control in a framework like a flowchart or an information stream chart. Action graphs are regularly utilized in

business measure demonstrating. They can likewise depict the means in an utilization case chart. Exercises demonstrated can be consecutive and simultaneous. In the two cases, an action outline will have a start (an underlying state) and an end (a last state).

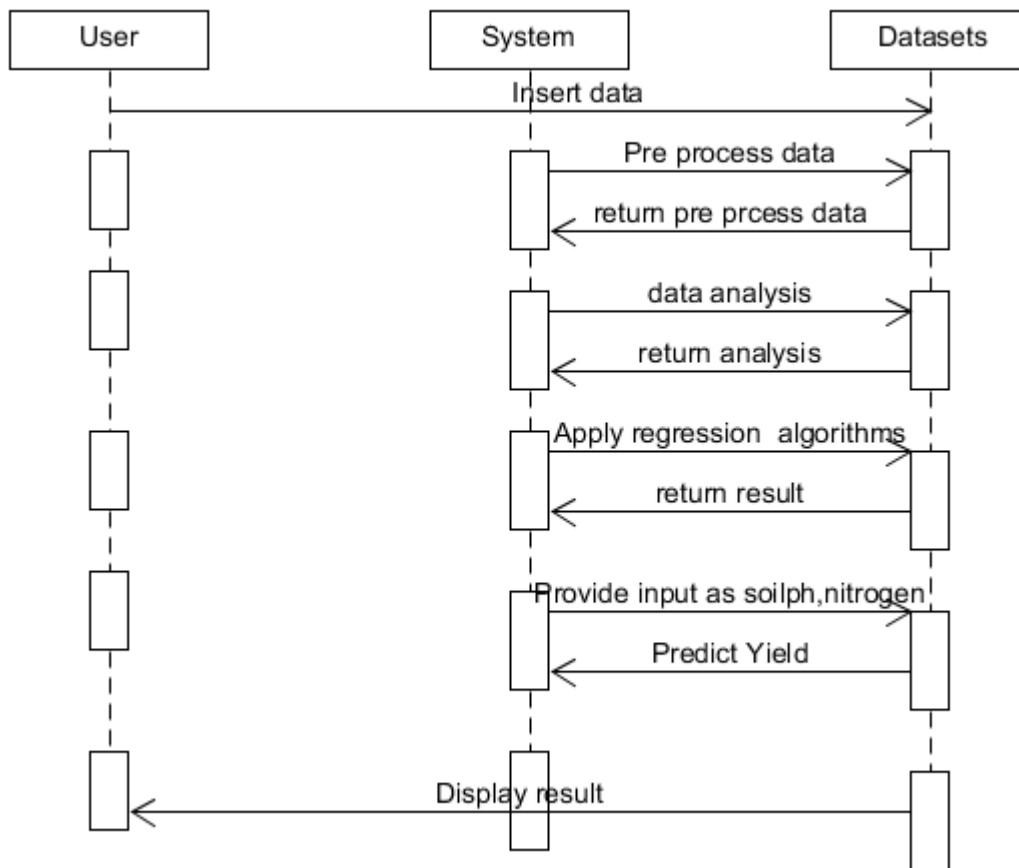
initial state) and an end (a final state).





Sequence Diagram:

sequence diagram depicts cooperations among classes as far as a trade of messages after some time. They're likewise called occasion charts. A grouping chart is a decent method to envision and approve different runtime situations. These can assist with anticipating how a framework will act and to find duties a class may need to have during the time spent demonstrating another framework.



Use case Diagram:

The motivation behind use case diagram is to catch the dynamic part of a framework. In any case, this definition is too nonexclusive to even think about describing the reason, as other four outlines (action, grouping, cooperation, and Statechart) likewise have a similar reason. We will investigate some particular reason, which will recognize it from other four charts.

Use case graphs are utilized to accumulate the prerequisites of a framework including inside and outside impacts. These prerequisites are generally plan necessities. Consequently, when a framework is investigated to accumulate its functionalities, use cases are readied and entertainers are distinguished.

At the point when the underlying assignment is finished, use case graphs are demonstrated to introduce the external view.

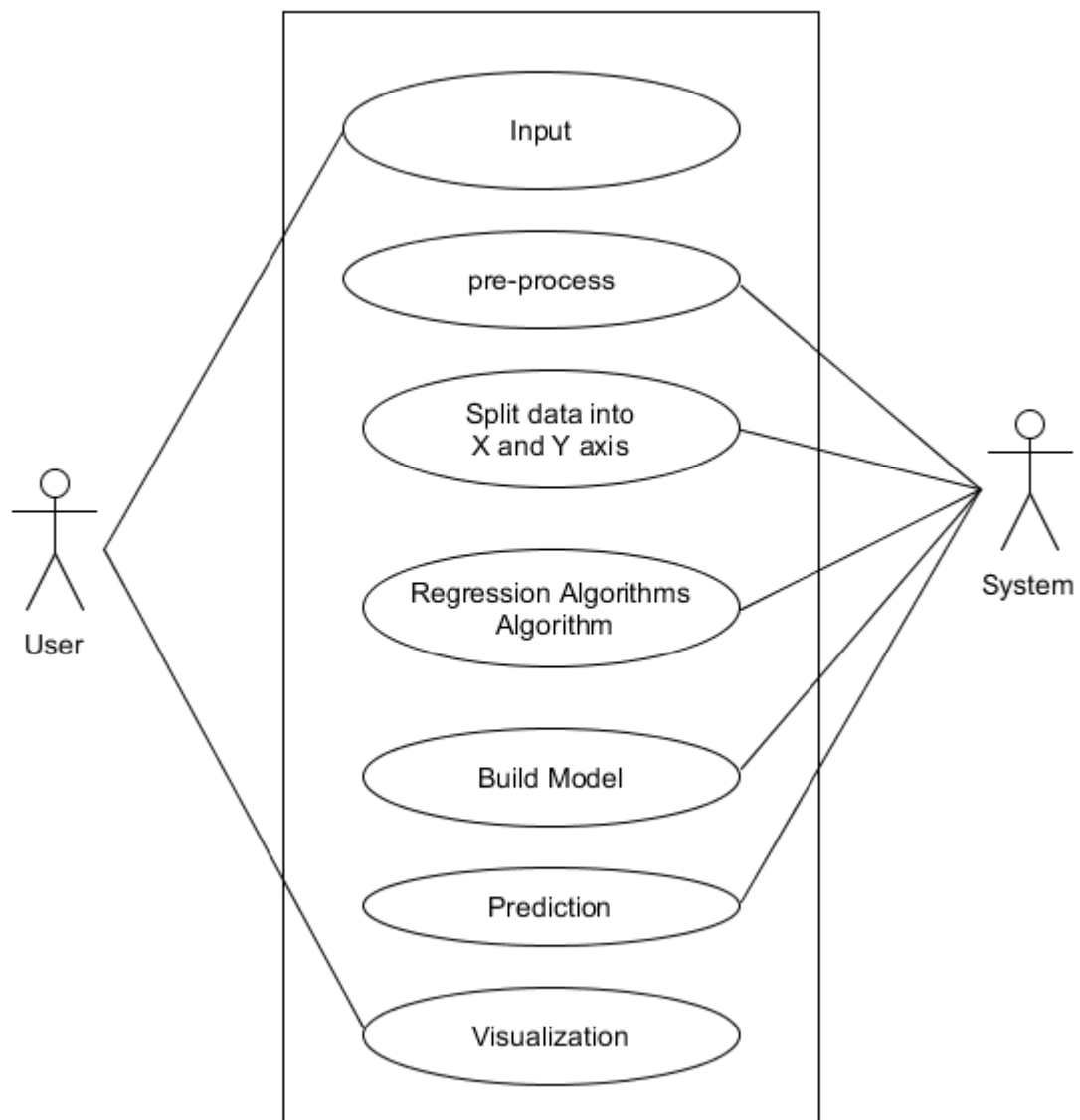
In a word, the motivations behind use case graphs can be supposed to be as per the following –

Used to accumulate the necessities of a framework.

Used to get an external perspective on a framework.

Distinguish the outside and inside elements affecting the framework.

Show the association among the necessities are entertainers.



3.3. Code Snippets

```

from flask import Flask, request, render_template, redirect, url_for, flash, session, jsonify
import pandas as pd
import numpy as np
from sklearn.ensemble import RandomForestRegressor
from sklearn.model_selection import train_test_split
import pyowm
from pyowm import OWM
from dotenv import load_dotenv
import os

app = Flask(__name__)
app.secret_key = 'API_KEY' # Required for using sessions and flash messages

# Load environment variables
load_dotenv()
api_key = os.getenv('API_KEY')

# Dummy credentials for simplicity
USERNAME = 'admin'
PASSWORD = '12345'

# Function to fetch weather data
def get_weather_data(api_key, location):
    try:
        owm = OWM(api_key)
        mgr = owm.weather_manager()
        observation = mgr.weather_at_place(location)
        weather = observation.weather
        return {
            'main': {
                'temp': weather.temperature('celsius')['temp']
            }
        }
    except Exception as e:
        print(f"Error fetching weather data: {e}")
        return None

# Route for the login page
@app.route("/", methods=["GET", "POST"])
def login():
    if request.method == "POST":
        username = request.form["username"]
        password = request.form["password"]

        if username == USERNAME and password == PASSWORD:
            session['logged_in'] = True
            flash("Login successful!", "success")
            return redirect(url_for('home'))
        else:
            flash("Invalid credentials, please try again.", "danger")

```

```

    return redirect(url_for('login'))

    return render_template("login.html")

# Route for the home page
@app.route("/home")
def home():
    if not session.get('logged_in'):
        return redirect(url_for('login'))
    return render_template("home.html")

# Route for the about page
@app.route('/about')
def about():
    return render_template('aboutus.html')

# Route to fetch available cities and their weather data
@app.route('/get-temperature', methods=['GET'])
def get_temperature():
    city = request.args.get('city')

    if city:
        location = f'{city},IN' # Assuming the country code for India is 'IN'
        weather_data = get_weather_data(api_key, location)
        if weather_data:
            temperature = weather_data['main']['temp']
            return jsonify({'temperature': temperature})
        else:
            return jsonify({'error': 'Failed to fetch weather data'}), 500
    else:
        return jsonify({'error': 'City not provided'}), 400

# Route for the prediction page
@app.route("/predict", methods=["GET", "POST"])
def predict():
    if not session.get('logged_in'):
        return redirect(url_for('login'))

    if request.method == "POST":
        try:
            # Get form data
            water = float(request.form["water"])
            UV = float(request.form["UV"])
            area = float(request.form["area"])
            fertilizer = float(request.form["fertilizer"])
            Pesticide = float(request.form["Pesticide"])
            Region = float(request.form["Region"])

            # Prepare data for prediction
            sample_data = [water, UV, area, fertilizer, Pesticide, Region]
            ex1 = np.array(sample_data).reshape(1, -1)

```

```

# Load dataset
data = pd.read_csv("dataset.csv")
data = data.drop(columns=['id', 'categories'], axis=1)

# Replace NaN values with median
data.water = data.water.fillna(data.water.median())
data.uv = data.uv.fillna(data.uv.median())

# Remove outliers
data = data[data['water'] <= 200]

# Split data into training and test sets
X = data.iloc[:, :-1].values
y = data.iloc[:, -1].values
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=3)

# Train the model
regressor = RandomForestRegressor(n_estimators=10, random_state=50)
regressor.fit(X_train, y_train)

# Make a prediction
yhat = regressor.predict(ex1)
res = yhat[0]
area = int(area)
result = 27.6 * res * area

return render_template('CropResult.html', prediction_text=res, area=area, result=result)
except Exception as e:
    flash(f"An error occurred: {e}", "danger")
    return redirect(url_for('home'))

# Route for the logout page
@app.route("/logout")
def logout():
    session.pop('logged_in', None)
    flash("You have been logged out.", "info")
    return redirect(url_for('login'))

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

#login page code
<!DOCTYPE html>

<html lang="en">

<head>

    <meta charset="UTF-8">

    <meta name="viewport" content="width=device-width, initial-scale=1.0">

    <title>Login</title>

    <link rel="stylesheet" href="{{ url_for('static', filename='stylesheets/login.css') }}">

```

```

</head>
<body>
  <header class="scrolling-header">
    <div class="scrolling-text">
      <p>Welcome to Smart-Yield</p>
    </div>
  </header>
  <div class="login-container">
    <h2>Login</h2>
    <form method="post" action="{{ url_for('login') }}">
      <label for="username">Username:</label>
      <input type="text" id="username" name="username" required>
      <label for="password">Password:</label>
      <input type="password" id="password" name="password" required>
      <input type="submit" value="Login">
    </form>
    {% with messages = get_flashed_messages(with_categories=True) %}
      {% if messages %}
        {% for category, message in messages %}
          <p class="flash-message {{ category }}">{{ message }}</p>
        {% endfor %}
      {% endif %}
    {% endwith %}
  </div>
</body>
</html>

```

#home page code

```

<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>SMART-YIELD</title>

```



```

<!-- Bootstrap Attachments -->
<link      href="https://cdn.jsdelivr.net/npm/bootstrap@5.0.0-beta2/dist/css/bootstrap.min.css"
rel="stylesheet"
    integrity="sha384-
BmbxuPwQa2lc/FVzBcNJ7UAyJxM6wuqIj61tLrc4wSX0szH/Ev+nYRRuWlolflfl"
crossorigin="anonymous">
<!-- Custom CSS -->
<style>
    h5 {
        color: black;
        font-size: 1.25rem;
    }
    .background-image-container {
        background-image: url('{{ url_for('static', filename='image/bg2.jpg') }}');
        background-size: cover;
        background-position: center;
        padding: 50px 20px;
        color: white;
        text-align: center;
        position: relative;
        min-height: 100vh;
    }
    .background-image-container::before {
        content: "";
        position: absolute;
        top: 0;
        left: 0;
        width: 100%;
        height: 100%;
        background-color: rgba(0, 0, 0, 0.5);
        z-index: 1;
    }
    .background-image-container .content {
        position: relative;
        z-index: 2;
    }

```

```

}

.card-body input,
.card-body select {
  width: 100%;
  padding: 10px;
  margin-top: 10px;
  border: none;
  border-radius: 5px;
}

.btn-dark {
  padding: 10px 20px;
  font-size: 18px;
  margin-top: 20px;
  background-color: #343a40;
  border: none;
  border-radius: 5px;
}

.navbar {
  background-color: rgba(82, 173, 198, 0.884);
  position: relative;
  display: flex;
  flex-wrap: wrap;
  align-items: center;
  justify-content: space-between;
  padding-top: .5rem;
  padding-bottom: .5rem;
}

.navbar-right {
  display: flex;
  align-items: center;
}

```

```

#city-dropdown {
    display: none;
    margin-left: 15px;
}

#temperature-display {
    margin-left: 10px;
}
</style>
</head>

<body>
<!-- Navigation Bar -->
<nav class="navbar navbar-expand-lg">
    <a class="navbar-brand" href="#">
        
        <span class="text-uppercase font-weight-bold">SMART-YIELD</span>
    </a>
    <button class="navbar-toggler" type="button" data-toggle="collapse" data-
target="#navbarSupportedContent"
        aria-controls="navbarSupportedContent" aria-expanded="false" aria-label="Toggle
navigation">
        <span class="navbar-toggler-icon"></span>
    </button>

    <div class="collapse navbar-collapse" id="navbarSupportedContent">
        <ul class="navbar-nav mr-auto">
            <li class="nav-item">
                <a class="nav-link" href="{ { url_for('home') } }">Home</a>
            </li>
            <li class="nav-item">
                <a class="nav-link" href="{ { url_for('about') } }">About Us</a>
            </li>

```

```

<li class="nav-item">
  <a class="nav-link" href="{ { url_for('login') } }">Logout</a>
</li>
</ul>
<!-- Align the button to the right end of the navigation bar -->
<div class="navbar-right">
  <button id="get-temperature-btn" class="btn btn-primary">Get Temperature</button>
  <div id="city-dropdown" class="mt-3">
    <select id="city-select" class="form-select">
      <option value="Gundlupet">Gundlupet</option>
      <option value="Chamrajnagar">Chamrajnagar</option>
      <option value="Mysore">Mysore</option>
      <option value="Alathur">Alathur</option>
      <option value="Avadi">Avadi</option>
      <option value="Bommanahalli">Bommanahalli</option>
      <option value="Kadaburu">Kadaburu</option>
    </select>
  </div>
  <div id="temperature-display" class="mt-3"></div>
</div>
</div>
</nav>
<div class="background-image-container">
  <div class="content">
    <!-- Input Form -->
    <div class="container">
      <form action="/predict" method="post">
        <div class="row">
          <div class="col-sm-6">
            <div class="card">
              <div class="card-body">
                <h5 class="card-title">Water Level</h5>
                <input type="text" name="water" placeholder="Water Level in soil"
id="water-input"
                required="required">

```

```

        </div>
    </div>
</div>
<div class="col-sm-6">
    <div class="card">
        <div class="card-body">
            <h5 class="card-title">Ultra Violet</h5>
            <input type="text" name="UV" placeholder="UV" id="uv"
required="required">
        </div>
    </div>
</div>
</div>
<br>
<div class="row">
    <div class="col-sm-6">
        <div class="card">
            <div class="card-body">
                <h5 class="card-title">Area</h5>
                <input type="text" name="area" placeholder="Area in Acre" id="area-input"
required="required">
            </div>
        </div>
    </div>
    <div class="col-sm-6">
        <div class="card">
            <div class="card-body">
                <h5 class="card-title">Fertilizer Usage</h5>
                <select name="fertilizer" id="fertilizer">
                    <option value="0">Cow Manure</option>
                    <option value="1">Compost</option>
                    <option value="2">Seaweed</option>
                    <option value="3">Emulsion</option>
                    <option value="4">Mushroom Compost</option>
                </select>
            </div>
        </div>
    </div>
</div>

```

```

        </div>
    </div>
</div>
<br>
<div class="row">
    <div class="col-sm-6">
        <div class="card">
            <div class="card-body">
                <h5 class="card-title">Pesticide</h5>
                <input type="text" name="Pesticide" placeholder="Relative humidity in %"
                    id="Pesticide-input" required="required">
            </div>
        </div>
    </div>
    <div class="col-sm-6">
        <div class="card">
            <div class="card-body">
                <h5 class="card-title">Region</h5>
                <select name="Region" id="Region">
                    <option value="0">Gundlupet</option>
                    <option value="1">Chamrajnagar</option>
                    <option value="2">Mysore</option>
                    <option value="3">Alathur</option>
                    <option value="4">Avadi</option>
                    <option value="5">Bommanahalli</option>
                    <option value="6">Kadabur</option>
                </select>
            </div>
        </div>
    </div>
</div>
<br>
<input type="submit" value="Submit" class="btn btn-dark">
</form>

```

```

</div>
</div>
</div>
<!-- Bootstrap JS Bundle with Popper -->
<script src="https://cdn.jsdelivr.net/npm/bootstrap@5.0.0-beta2/dist/js/bootstrap.bundle.min.js"
    integrity="sha384-
pzjw8f+ua7Kw1TIqOGiATWNbA7LrGi27q6BPE2eeFhi1B8gKjP5xNqL3Fe4W1A25"
crossorigin="anonymous"></script>
<script>
    document.getElementById('get-temperature-btn').onclick = function() {
        document.getElementById('city-dropdown').style.display = 'block'; // Show the dropdown
when the button is clicked
    };
    document.getElementById('city-select').onchange = function() {
        const city = this.value;
        fetch(/get-temperature?city=${city})
        .then(response => response.json())
        .then(data => {
            if (data.temperature) {
                document.getElementById('temperature-display').innerText = Current Temperature
in ${city}: ${data.temperature}°C;
            } else {
                document.getElementById('temperature-display').innerText = 'Error fetching
temperature data';
            }
        })
        .catch(error => {
            console.error('Error:', error);
            document.getElementById('temperature-display').innerText = 'Error fetching
temperature data';
        });
    };
</script>
</body>
</html>

```

```
#about us code
```

```
<!DOCTYPE html>
```

```
<html lang="en">
```

```
<head>
```

```
  <meta charset="UTF-8">
```

```
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
```

```
  <title>About Us</title>
```

```
  <link rel="stylesheet" href="{{ url_for('static', filename='stylesheets/aboutus.css') }}">
```

```
</head>
```

```
<body>
```

```
  <div class="scrolling-header">
```

```
    <p class="scrolling-text">Welcome to Smart Yield | Project by Inamulla</p>
```

```
  </div>
```

```
  <div class="about-container">
```

```
    <h1>About Us</h1>
```

<p>In the ever-evolving world of agriculture, optimizing crop yields is more crucial than ever. Our project, "SmartYield: Cotton Yield Prediction," is dedicated to advancing this goal by harnessing the power of machine learning and data mining. We aim to provide accurate and actionable insights for farmers and agronomists by integrating a wide array of datasets, including historical yield records, meteorological data, soil conditions, and pest incidences.

Our approach is rooted in rigorous data preprocessing and feature engineering, ensuring that our predictive model is not only robust and reliable but also interpretable. We employ sophisticated machine learning algorithms to build a model that not only achieves high prediction accuracy but also delivers insights that are comprehensible and practical for stakeholders in the agricultural sector.

At SmartYield, our mission is to bridge the gap between advanced technology and agricultural practice, empowering those in the field with tools and insights that drive better decision-making and optimized crop yields..</p>

```
    <h2>Our Mission</h2>
```

<p>At SmartYield, our mission is to revolutionize cotton yield prediction through cutting-edge technology and data integration. We are dedicated to:

Data Collection and Integration: Collecting and integrating a diverse range of datasets—including historical yield records, weather data, soil properties, pest and disease incidences, and satellite imagery. Our goal is to build a comprehensive and robust dataset that enhances the accuracy and reliability of our predictive model.


```

height: 400px;
/* Adjust the height as needed */
color: white;
text-align: center;
padding-top: 50px;
/* Adjust padding to position content */
}
/* Dark overlay to improve text readability */
.background-image-container::before {
  content: "";
  position: absolute;
  top: 0;
  left: 0;
  width: 100%;
  height: 100%;
  background-color: rgba(0, 0, 0, 0.5);
  /* Adjust the opacity as needed */
  z-index: 1;
}
/* Ensuring the content is above the overlay */
.background-image-container .container {
  position: relative;
  z-index: 2;
}
/* Additional styling for text */
h2,
h3 {
  margin: 10px 0;
}
</style>
</head>
<body>
  <!-- Navigation Bar -->
  <nav class="navbar navbar-expand-lg">
    <a class="navbar-brand" href="#">

```

```

<!-- Logo Image -->

<!-- Logo Text -->
<span class="text-uppercase font-weight-bold">SMART-YIELD</span>
</a>
<button    class="navbar-toggler"    type="button"    data-toggle="collapse"    data-
target="#navbarSupportedContent"
    aria-controls="navbarSupportedContent"    aria-expanded="false"    aria-label="Toggle
navigation">
    <span class="navbar-toggler-icon"></span>
</button>
<div class="collapse navbar-collapse" id="navbarSupportedContent">
    <ul class="navbar-nav mr-auto">
        <li class="nav-item">
            <a class="nav-link" href="#">Home</a>
        </li>
        <li class="nav-item">
            <a class="nav-link" href="#">About Us</a>
        </li>
        <li class="nav-item">
            <a class="nav-link" href="{ { url_for('home') } }">Back</a>
        </li>
    </ul>
</div>
</nav>
<div class="background-image-container">
    <div class="container">
        <h2>Yield = { { prediction_text } }</h2>
        <h3>Bushels 1 Bushel = 27.6 KG</h3>
        <h3>Total yield for { { area } } acre: { { result } } KG</h3>
    </div>
</div>
<br><br><br>
<!-- Cards for more info on features -->
<section class="white-section">

```

```

<h2 class="section-heading">Information regarding some features</h2>
<div class="row">
  <div class="col-lg-4 col-md-6">
    <div class="card">
      <div class="card-header">
        <h3>Importance of Minerals</h3>
      </div>
      <div class="card-body">
        <a href="https://organicnz.org.nz/magazine-articles/role-importance-nitrogen-soil/"
class="links">Nitrogen</a><br>

<a href="https://www.dpi.nsw.gov.au/agriculture/soils/improvement/phosphorous#:~:text=Phosphor
us%20is%20one%20of%20the,for%20seedlings%20and%20young%20plants."
class="links">Phosphorus</a><br>
        <a href="https://www.smart-fertilizer.com/articles/potassium-in-
plants/#:~:text=Potassium%20triggers%20activation%20of%20enzymes,of%20Adenosine%20Trip
hosphate%20(ATP).&text=Both%20uptake%20of%20water%20through,plants%20require%20pota
ssium%20as%20well." class="links">Potassium</a>
      </div>
    </div>
  </div>
  <div class="col-lg-4 col-md-6">
    <div class="card">
      <div class="card-header">
        <h3>Importance of Temperature and Humidity Level</h3>
      </div>
      <div class="card-body">
        <a href="https://eos.com/blog/soil-
temperature/#:~:text=Soil%20Temperature%20As%20A%20Factor%20Of%20Crops%20Develop
ment&text=The%20temperature%20of%20soil%20is,soil%20temperature%20for%20seed%20ger
mination." class="links">Temperature</a><br>

<a href="https://weather.msfc.nasa.gov/landprocess/#:~:text=Soil%20moisture%20is%20a%20key,
and%20the%20production%20of%20precipitation" class="links">Humidity Level</a>
      </div>
    </div>
  </div>
</div>

```

```

</div>
</div>
<div class="col-lg-4 col-md-6">
  <div class="card">
    <div class="card-header">
      <h3>Importance of PH value and Rainfall Level</h3>
    </div>
    <div class="card-body">
      <a href="https://hortnews.extension.iastate.edu/2002/5-24-2002/soilph.html#:~:text=A%20pH%20of%20%20indicates,and%207.5%20(slightly%20alkaline)." class="links">PH Value</a><br>
      <a href="https://www.sigfox.com/en/news/how-rainfall-affects-crop-health#:~:text=Soil%20is%20also%20greatly%20affected,mold%20growth%20in%20the%20soil." class="links">Rainfall Level</a>
    </div>
  </div>
</div>
</div>
</div>
</section>
<!-- JavaScript -->
<!-- Option 2: Separate Popper and Bootstrap JS -->
<script src="https://cdn.jsdelivr.net/npm/@popperjs/core@2.6.0/dist/umd/popper.min.js"
  integrity="sha384-
KsvD1yqQ1/1+IA7gi3P0tyJcT3vR+NdbTt13hSJ2lnve8agRGXTTyNaBYmCR/Nwi"
  crossorigin="anonymous"></script>
<script src="https://cdn.jsdelivr.net/npm/bootstrap@5.0.0-beta2/dist/js/bootstrap.min.js"
  integrity="sha384-
nsg8ua9HAW1y0W1btsyWgBklPnCUAFLuTMS2G72MMONqmOymq585AcH49TLBQObG"
  crossorigin="anonymous"></script>
</body>
</html>
#css
.background-image-container {
  background-image: url('/static/image/bg2.jpg'); /* replace with your image URL */
  background-size: cover; /* optional, but recommended for a full-screen background */

```

```

height: 100vh; /* optional, but recommended for a full-screen background */
width: 100vw; /* optional, but recommended for a full-screen background */
}
body {
background-color: rgb(234, 231, 231);
text-align: center;
font-family: 'Cabin', sans-serif;
}
.navbar {
background-color: rgba(82, 173, 198, 0.884); /* Change the navbar background color to black */
font-family: 'Playfair Display', serif;
font-weight: bolder;
}
.nav-link {
color: rgb(16, 17, 17);
}
/* Temperature button and display styling */
.temperature-container {
display: flex;
justify-content: flex-end; /* Aligns the container to the right */
padding: 1rem; /* Adjust padding as needed */
}
.temperature-item {
display: flex;
align-items: center;
}
#temperature-display {
margin-left: 10px; /* Adjust spacing between button and display */
}
.text-uppercase, .submission-text, .legend {
color: rgb(22, 21, 21);
}
.reference {
text-align: center;
}

```

```

.northkeysLogo {
  position: relative;
  right: 70px;
}
.logo {
  margin-left: 30px;
  margin-right: 10px;
}
.jumbotron {
  margin-top: 20px;
  margin-bottom: 40px;
  color: rgb(8, 8, 8);
  /* right: 40px; */
}
.jumbo-text {
  margin-top: 30px;
}
.display-4 {
  color: white;
}
.problem-statement {
  color: white;
}
.img-fluid {
  margin-bottom: 20px;
  image-orientation: center;
}
.card-body {
  background-color: rgb(70, 68, 68);
  color: white;
  font-weight: bolder;
}
.card:hover {
  background-color: rgba(0,0,0,0.8);
  box-shadow: 0 8px 16px 4px rgba(255, 255, 255, 0.8);
}

```



```

}
.btn:hover{
    background-color: rgb(255, 255, 255);
    color: rgb(0, 0, 0);}
::placeholder {
    color: rgb(24, 24, 24);
    text-align: center; }
.btn {
    margin-bottom: 20px; }
/* .form-text {
    color: Black;
} */
#small-text {
    background-color: blacksmoke;
}
.footer {
    position: fixed;
    left: 0;
    bottom: 0;
    width: 100%;
}
.my-contr {
    color: Black;
}
.links {
    color: white;
    margin-bottom: 50px;
}
.section-heading {
    margin-bottom: 30px;
    color: rgb(10, 10, 10);
}
.card-header {
    color: rgb(6, 5, 5);
}

```



4.TESTING AND EVALUATION

4.1. Introduction to Testing

Testing is a fundamental aspect of developing robust and reliable software applications, ensuring that they meet the intended requirements and function correctly under various conditions. The testing process for a cotton yield prediction involves a structured approach to ensure that the software performs efficiently and meets the needs of its users. Initially, **unit testing** focuses on individual components or functions to verify their correctness. Following this, **integration testing** examines how these components work together, ensuring seamless data flow and functionality across the system. **Functional testing** assesses whether the application's features meet specified requirements and user expectations, while **usability testing** evaluates the application's ease of use and overall user experience. **Performance testing** checks the application's behavior under various loads and stress conditions to ensure it remains responsive and stable. **Security testing** identifies potential vulnerabilities and ensures that user data is protected against unauthorized access. **Regression testing** ensures that new updates or bug fixes do not adversely affect existing features and etc.

By meticulously conducting these testing phases, developers can address issues proactively, enhance the application's functionality and performance, and ultimately deliver a robust and user-friendly prediction tool. Testing is an ongoing process and essential for delivering a reliable and effective work-based learning application. By implementing various testing methods and best practices, you can ensure that the application performs well, meets user expectations, and provides a valuable learning experience.

4.2. Different Testing Used in Your Testing

1. Unit Testing

- **Objective:** Verify that individual components of the system function correctly.
- **Scope:** Test the functionality of individual algorithms, data preprocessing modules, feature engineering components, and user interface elements.
- **Example:** Test the correctness of data cleaning functions, validation of input parameters, and the accuracy of output predictions for isolated cases.

2. Integration Testing

- **Objective:** Ensure that different components of the system work together as expected.

- **Scope:** Test the interaction between data ingestion modules, machine learning algorithms, and prediction output systems.
- **Example:** Verify that the data flows correctly from the input stage through preprocessing, model prediction, and output display without errors.

3. System Testing

- **Objective:** Validate the complete system against the specified requirements and use cases.
- **Scope:** Conduct end-to-end testing of the entire prediction system, including user interactions and the overall workflow.
- **Example:** Test scenarios where users input data, receive predictions, and interpret results, ensuring that the system meets functional requirements and provides accurate results.

4. Performance Testing

- **Objective:** Assess how well the system performs under various conditions.
- **Scope:** Measure the system's response time, scalability, and resource usage.
- **Example:** Evaluate the system's performance with large datasets, multiple concurrent users, and different computational loads to ensure it can handle real-world scenarios efficiently.

5. Accuracy and Precision Testing

- **Objective:** Determine the accuracy and reliability of the predictions made by the machine learning models.
- **Scope:** Compare predicted yields against actual yields using metrics such as Root Mean Squared Error (RMSE), R^2 score, Mean Absolute Percentage Error (MAPE), and other relevant metrics.
- **Example:** Use a separate test dataset to evaluate how well the models generalize to unseen data and refine them based on performance results.

6. Cross-Validation

- **Objective:** Validate the robustness and generalizability of the machine learning models.
- **Scope:** Implement k-fold cross-validation to assess model performance on different subsets of the data.
- **Example:** Split the data into multiple folds, train the models on some folds, and test on the remaining folds to ensure consistent performance across different data segments.

7. Regression Testing

- **Objective:** Ensure that new changes or enhancements do not adversely affect existing functionality.
- **Scope:** Re-test previously passed test cases after updates to the system.
- **Example:** After adding new features or modifying algorithms, verify that previous functionalities such as prediction accuracy and user interface elements still work as expected.

8. User Acceptance Testing (UAT)

- **Objective:** Confirm that the system meets user needs and requirements.
- **Scope:** Test the system with actual users or stakeholders to gather feedback and identify any usability issues or discrepancies.
- **Example:** Conduct testing sessions with farmers or agricultural experts to validate the system's usability, accuracy of predictions, and overall user experience.

9. Security Testing

- **Objective:** Identify and address potential security vulnerabilities in the system.
- **Scope:** Test for data privacy, secure access controls, and protection against unauthorized access.
- **Example:** Assess how well the system protects sensitive data and verify that only authorized users can access or modify information.

10. Compatibility Testing

- **Objective:** Ensure that the system functions correctly across different environments and platforms.
- **Scope:** Test the system on various operating systems, browsers, and devices to confirm compatibility.
- **Example:** Verify that the web interface works across different web browsers and that the system performs consistently on different hardware configurations.

11. Regression Testing

- **Objective:** Ensure that recent changes have not introduced new issues.
- **Scope:** Re-test the system after any updates or bug fixes to ensure previous functionalities remain unaffected.
- **Example:** After implementing new features or fixing bugs, re-test the core functionalities to ensure they still operate correctly.

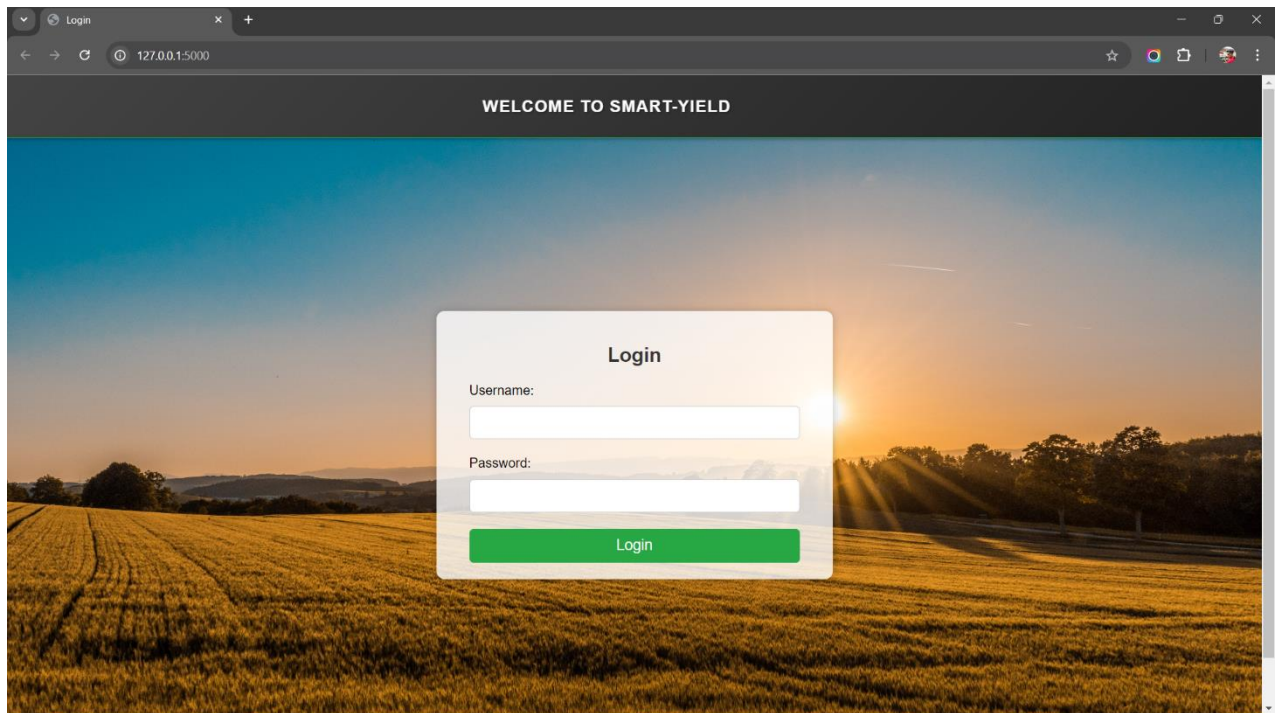
12. Load Testing

- **Objective:** Determine how the system behaves under high user loads or large data volumes.
- **Scope:** Simulate high traffic or large datasets to evaluate system performance and stability.
- **Example:** Test how the system handles simultaneous requests from multiple users or processes large volumes of data without performance degradation.

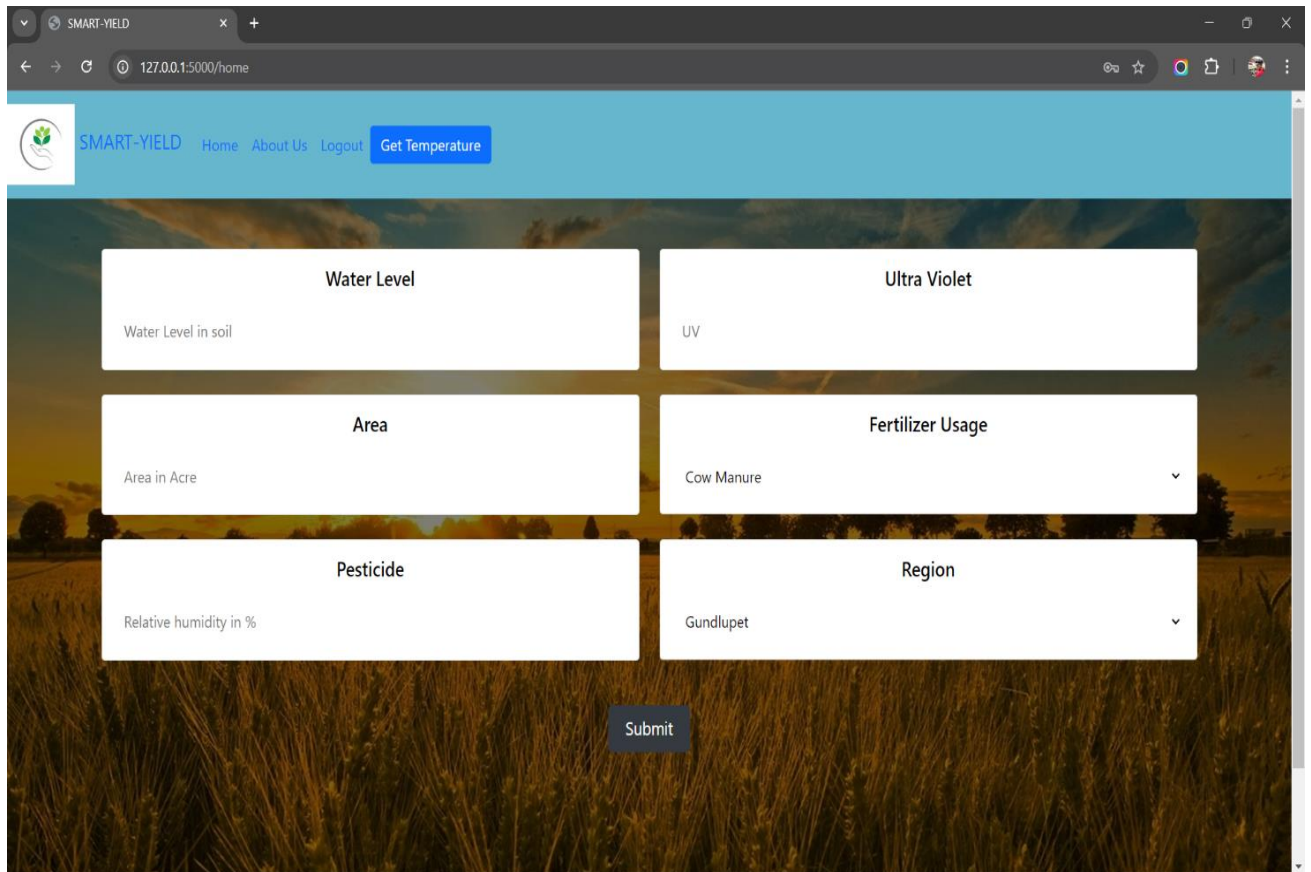


5. OUTPUT SCREENS

○ Login page



○ Home page

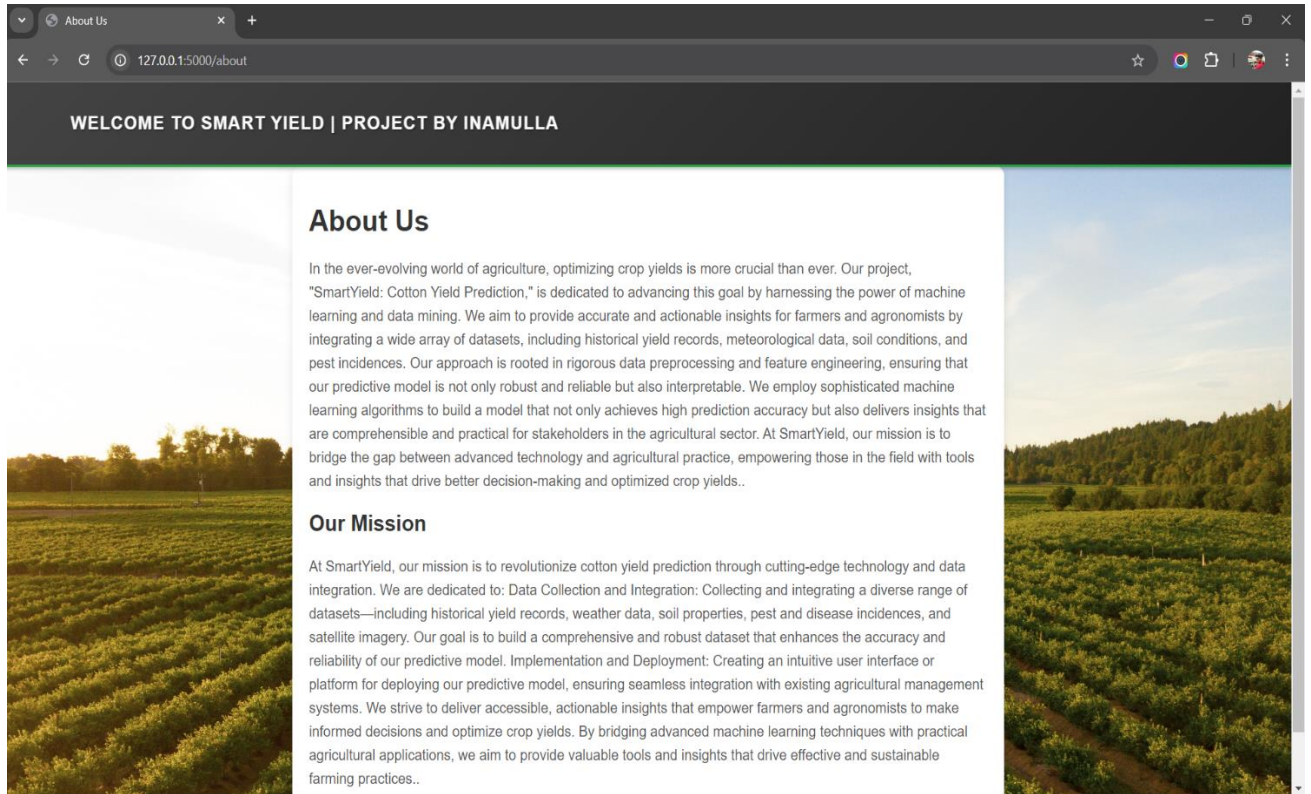


The screenshot shows a web browser window with the URL 127.0.0.1:5000/home. The page features a blue header with the SMART-YIELD logo and navigation links: Home, About Us, Logout, and a blue button labeled 'Get Temperature'. The main content area has a background image of a field and contains six white input boxes arranged in a 3x2 grid. The boxes are labeled: 'Water Level' (with subtext 'Water Level in soil'), 'Ultra Violet' (with subtext 'UV'), 'Area' (with subtext 'Area in Acre'), 'Fertilizer Usage' (with subtext 'Cow Manure' and a dropdown arrow), 'Pesticide' (with subtext 'Relative humidity in %'), and 'Region' (with subtext 'Gundlupet' and a dropdown arrow). A blue 'Submit' button is centered at the bottom of the grid.

Water Level Water Level in soil	Ultra Violet UV
Area Area in Acre	Fertilizer Usage Cow Manure ▼
Pesticide Relative humidity in %	Region Gundlupet ▼

Submit

○ About us page



○ Temperature

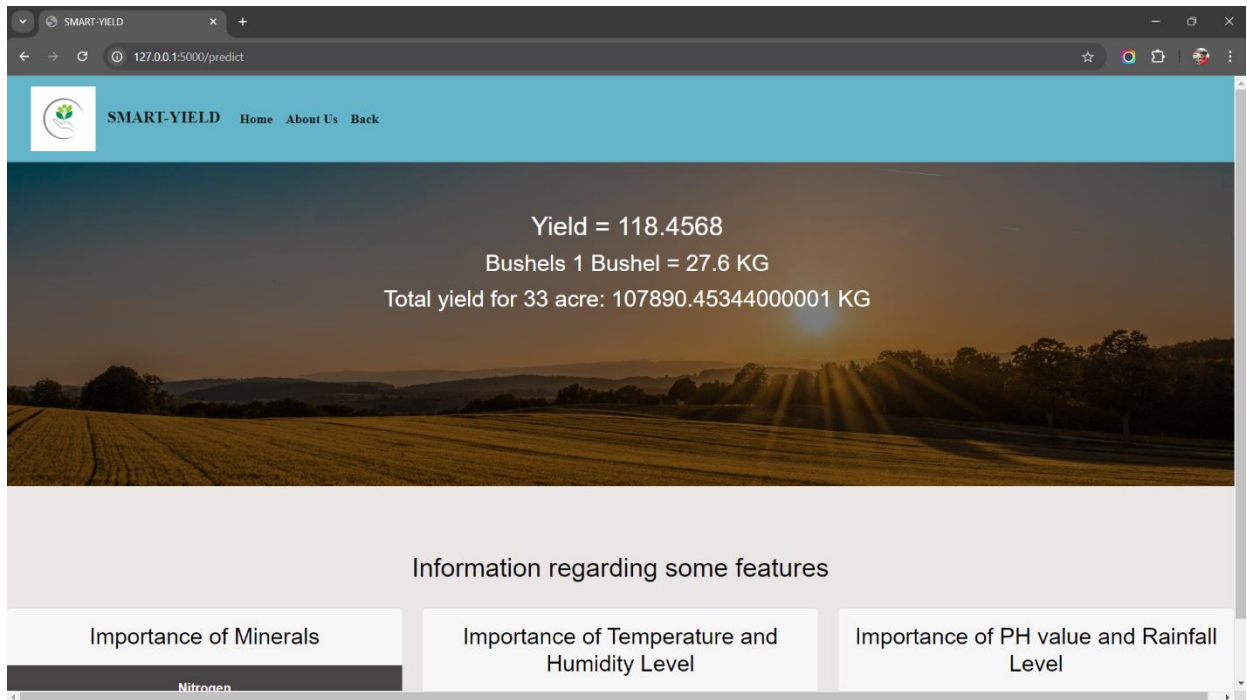
The screenshot displays the SMART-YIELD web application in a browser window. The address bar shows the URL 127.0.0.1:5000/home. The application header includes the SMART-YIELD logo, navigation links (Home, About Us, Logout), and a 'Get Temperature' button. A dropdown menu is set to 'Mysore', and the current temperature is displayed as 20.8°C. The main content area features six data cards: Water Level (169), Ultra Violet (55), Area (33), Fertilizer Usage (Emulsion), Pesticide (12), and Region (Mysore). A 'Submit' button is located at the bottom center of the dashboard. The background of the dashboard is a field of golden wheat under a sunset sky.

Parameter	Value
Water Level	169
Ultra Violet	55
Area	33
Fertilizer Usage	Emulsion
Pesticide	12
Region	Mysore

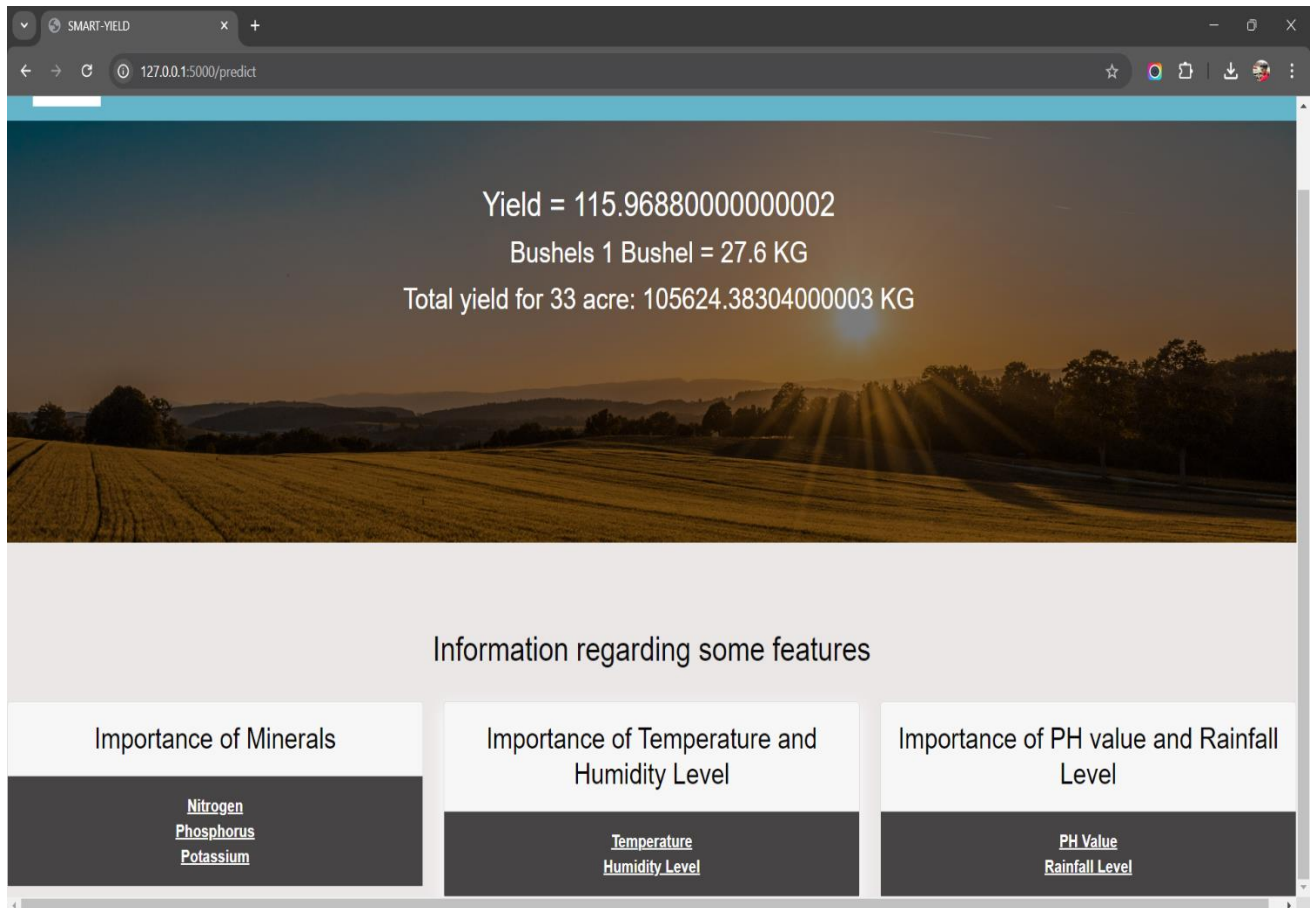
- **After inserting values**

The screenshot displays the SMART-YIELD web application interface. The browser address bar shows the URL 127.0.0.1:5000/home. The application header includes the SMART-YIELD logo, navigation links (Home, About Us, Logout), a 'Get Temperature' button, a location dropdown menu set to 'Mysore', and a status message 'Current Temperature in Mysore: 20.8°C'. The main content area features six input fields arranged in a 3x2 grid: 'Water Level' (value 169), 'Ultra Violet' (value 55), 'Area' (value 33), 'Fertilizer Usage' (dropdown menu showing 'Emulsion'), 'Pesticide' (value 12), and 'Region' (dropdown menu showing 'Mysore'). A 'Submit' button is located at the bottom center of the form. The background of the form is a field of golden wheat under a sunset sky.

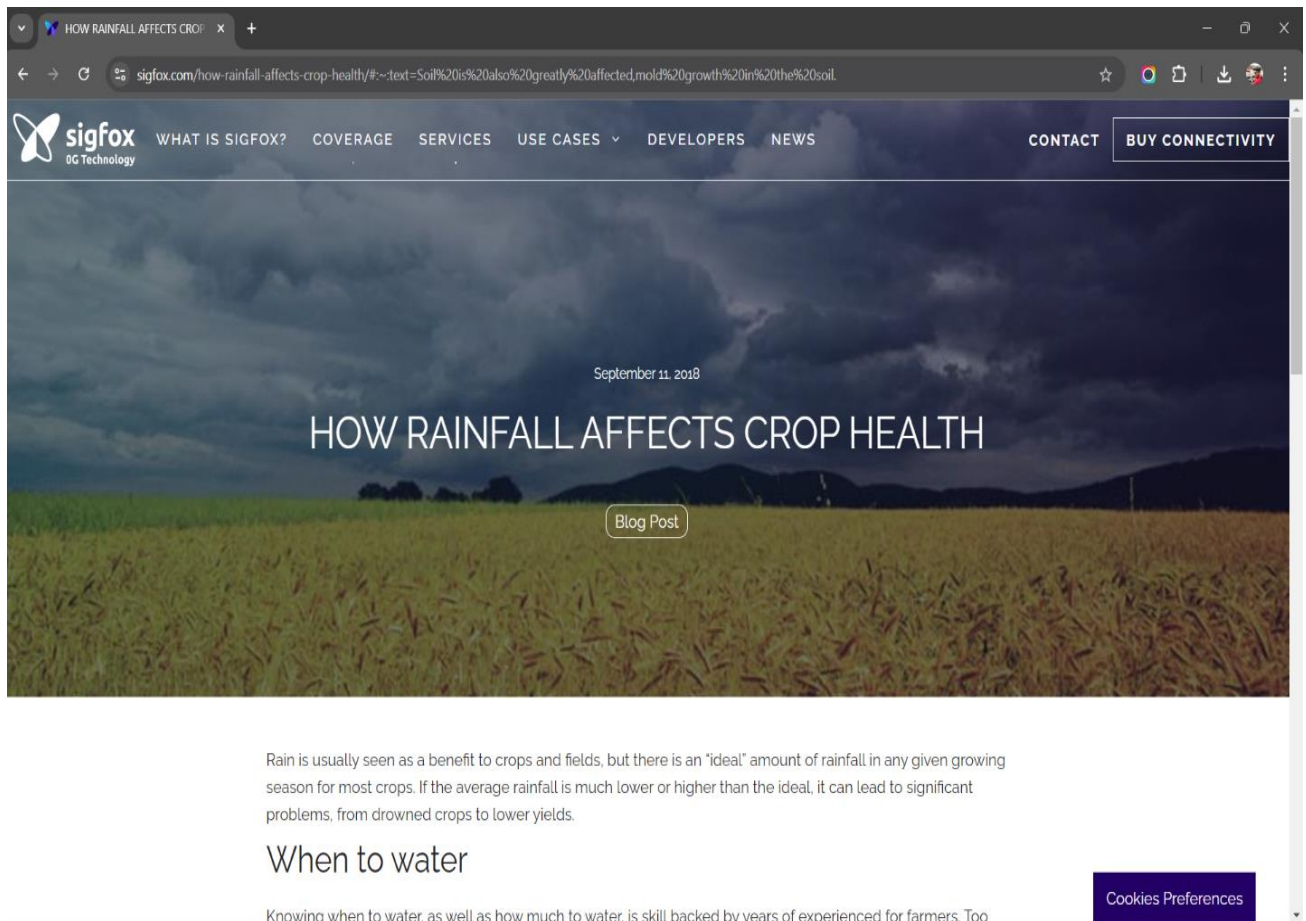
○ Prediction page



○ Importance



○ Ex - 1: Importance of Rainfall



The screenshot shows a web browser displaying a blog post on the Sigfox website. The browser's address bar shows the URL: `sigfox.com/how-rainfall-affects-crop-health/#~:text=Soil%20is%20also%20greatly%20affected,mold%20growth%20in%20the%20soil.` The website's navigation bar includes the Sigfox logo, a menu with 'WHAT IS SIGFOX?', 'COVERAGE', 'SERVICES', 'USE CASES', 'DEVELOPERS', and 'NEWS', and links for 'CONTACT' and 'BUY CONNECTIVITY'. The main content area features a large image of a field under a stormy sky. The article title 'HOW RAINFALL AFFECTS CROP HEALTH' is centered over the image, with a date 'September 11, 2018' above it and a 'Blog Post' button below it. The text of the article begins with: 'Rain is usually seen as a benefit to crops and fields, but there is an "ideal" amount of rainfall in any given growing season for most crops. If the average rainfall is much lower or higher than the ideal, it can lead to significant problems, from drowned crops to lower yields.' Below this, the section header 'When to water' is visible, followed by the start of a paragraph: 'Knowing when to water, as well as how much to water, is skill backed by years of experienced for farmers. Too'. A 'Cookies Preferences' button is located in the bottom right corner of the page.

September 11, 2018

HOW RAINFALL AFFECTS CROP HEALTH

Blog Post

Rain is usually seen as a benefit to crops and fields, but there is an "ideal" amount of rainfall in any given growing season for most crops. If the average rainfall is much lower or higher than the ideal, it can lead to significant problems, from drowned crops to lower yields.

When to water

Knowing when to water, as well as how much to water, is skill backed by years of experienced for farmers. Too

Cookies Preferences

○ Ex – 2: Importance of Temperature

The screenshot shows a web browser displaying a blog post from EOS Data Analytics. The page title is "Soil Temperature As A Factor Of Crops Development". The article discusses the importance of soil temperature in farming, noting that it determines whether plants can thrive and affects crop development. It mentions that monthly, seasonal, and daily fluctuations of ground temperature profoundly affect plant growth, and farmers must regulate them, especially during the hottest times. The page includes a "Table Of Contents" dropdown menu and a "CROP monitoring" sidebar with a "Free Pro field as a gift!" offer and a "REQUEST A DEMO" button. The sidebar also mentions "High-tech agriculture tool bringing reliable field analytics to farmers, traders, and insurers!".

EOS DATA ANALYTICS

Products Solutions Company Partnership EOS SAT-1 Blog Contact Us

SEE HOW WAR AFFECTS UKRAINE'S CROPS

FIND OUT

50 120
40 100

Last updated: 30.01.2023

SOIL

Share to:

in f X e

Soil Temperature As A Factor Of Crops Development

Soil temperature is an essential factor in farming because it determines whether plants can thrive in the environment. Soil temperature importance at the very beginning of crop development also determines the time for sowing and planting.

Since monthly, seasonal, and daily fluctuations of the ground's temperature profoundly affect plant growth, farmers must regulate them, specifically during the hottest times when the sun is most intense. Farmers can optimize the timing of field activities by learning more about how the temperature of soil is affecting plant growth.

Table Of Contents

What Is Soil Temperature And Why Is It Important?

Free Pro field as a gift!

High-tech agriculture tool bringing reliable field analytics to farmers, traders, and insurers!

REQUEST A DEMO

TRY NOW

6. CONCLUSION

The impact of this project extends beyond mere yield prediction. By providing accurate, data-driven insights, the system supports informed decision-making, optimizes agricultural practices, and potentially increases crop yields. The ability to predict and analyze cotton yields with high precision is invaluable for farmers aiming to enhance productivity and profitability in a competitive agricultural landscape.

Looking ahead, the integration of diverse data sources, adoption of cutting-edge machine learning techniques, and expansion to broader regions and crop varieties will further strengthen the system's capabilities. These advancements will not only improve the accuracy and relevance of predictions but also contribute to the broader goal of sustainable and efficient agriculture.

In conclusion, the cotton yield prediction system stands as a pioneering effort in harnessing the power of predictive analytics and machine learning to transform agricultural practices. Its current achievements and proposed enhancements collectively position it as a critical tool for advancing agricultural productivity, supporting farmers, and driving innovation in the agricultural sector. As we move forward, continuous improvements and expansions will ensure that the system remains at the forefront of agricultural technology, delivering actionable insights and fostering a more productive and sustainable agricultural future.

7. FUTURE WORK OR ENHANCEMENTS

1. Expansion to Different Cotton Varieties

- **Data Collection:** Gather data specific to various cotton varieties, including their growth patterns, yield characteristics, and responses to different environmental conditions.
- **Model Development:** Train and validate separate models for each cotton variety, or create a unified model that can account for variety differences.
- **User Interface:** Update the system to allow users to select cotton varieties and get tailored predictions.

2. Geographical Expansion

- **Regional Models:** Develop separate models for different regions if necessary, considering the unique environmental and soil conditions.
- **Model Integration:** Implement a system where users can select their location, and the model will automatically adapt to provide predictions for that area.
- **Visualization:** Incorporate geographical maps and visualizations to show prediction results across different regions.

3. Advanced Machine Learning Techniques

- **Deep Learning:** Explore deep learning models such as neural networks that might capture complex patterns in data more effectively.
- **Ensemble Methods:** Implement ensemble methods like Random Forest or Gradient Boosting to combine the strengths of various algorithms.
- **Hyperparameter Tuning:** Use techniques like Grid Search or Bayesian Optimization to fine-tune model parameters for better performance.

4. Collaboration with Agricultural Experts

- **Expert Reviews:** Regularly review models and predictions with agricultural experts to validate and improve them.
- **Feedback Loops:** Create mechanisms for users to provide feedback, which can be used to refine models and improve predictions.

8. BIBLIOGRAPHY/REFERENCES

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7. Datasets from "Directorate of Economics and Statistics" ANNUAL RAINFALL REPORT OF 2011.
8. Datasets from "Directorate of Economics and Statistics" ANNUAL RAINFALL REPORT OF 2014.
9. Datasets from "Directorate of Economics and Statistics" ANNUAL RAINFALL REPORT OF 2015.
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