SMART CROP ADVISORY SYSTEM

Minor Project Synopsis

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

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

SUBMITTED BY:

ABHAY MAURYA (221620101001) **AMIT YADAV** (221620101010)

VARUN RANA (221620101059) **SHANU AHMED** (731620101003)

SAMEER AHMAD (731620101005)

Under the able guidance of

Mrs. Sneh Lata Singh

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DR. A.P.J. ABDUL KALAM INSTITUTE OF TECHNOLOGY

TANAKPUR (CHAMPAWAT, UTTARAKHAND) – 262309

(CAMPUS INSTITUTE OF)

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

September– January, 2025

DR. A.P.J. ABDUL KALAM INSTITUTE OF TECHNOLOGY, TANAKPUR

(A Campus Institute of)

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

TANAKPUR, (CHAMPAWAT, UTTARAKHAND) – 262309

CERTIFICATE

This is to certify that the Minor Project entitled **"Smart Crop Advisory System"** has been successfully completed and submitted by the following students:

Group Members	**Roll No.**
Abhay Maurya	221620101001
Amit Yadav	221620101010
Varun Rana	221620101059
Shanu Ahmed	731620101003
Sameer Ahmad	731620101005

This Minor Project is a record of the students' original work carried out by them in partial fulfilment of the requirements for the award of the **degree of Bachelor of Technology in Computer Science and Engineering** from **Dr. A.P.J. Abdul Kalam Institute of Technology, Tanakpur (Campus Institute of VMSBUTU, Dehradun), Uttarakhand, India.**

Mrs. Sneh Lata Singh

(Project Mentor)

Mr. Naresh Kumar

(HOD, Department of CSE)

ACKNOWLEDGEMENT

We would like to express our deepest gratitude to our project mentor, **Mr. Naresh Kumar**, for his valuable guidance, constant encouragement, and insightful suggestions throughout the development of our minor project **"Smart Crop Advisory System."** His expertise, patience, and constructive feedback played a crucial role in shaping this project and bringing it to successful completion.

We extend our sincere thanks to **Mr. Naresh Kumar**, Head of the Department (CSE), for his continuous support, motivation, and for providing us with the facilities and environment necessary for the successful execution of this project.

We are also thankful to all the **faculty members and technical staff** of the **Department of Computer Science & Engineering**, Dr. A.P.J. Abdul Kalam Institute of Technology, Tanakpur, for their guidance and assistance during different stages of the project.

We would also like to convey our heartfelt gratitude to our **classmates, seniors, and friends** for their cooperation, valuable inputs, and encouragement throughout this project. Their moral support and feedback have greatly contributed to the refinement of our work.

Finally, we gratefully acknowledge the contributions of **Er. Sneh Lata Singh, Er. Rishabh Kushawah, Er. Amit Yadav, Er. Divisth Jaiswal, Er. Neha Bisht, Er. Komal Gahtori, and Er. Shreya Bisht** for their academic guidance and constant support during the entire course of this minor project.

Name	Roll No.	Signature
Abhay Maurya	221620101001	.....
Amit Yadav	221620101010	.....
Varun Rana	221620101059	.....
Shanu Ahmed	731620101003	.....
Sameer Ahmad	731620101005	.....

ABSTRACT

The **Smart Crop Advisory System (SCAS)** is an AI-powered, multilingual web application aimed at empowering small and marginal farmers with intelligent agricultural insights. It bridges the gap between traditional intuition-based decisions and data-driven precision farming by offering crop, fertilizer, and pest recommendations using machine learning and deep learning techniques. The system integrates weather APIs for real-time predictions and CNN-based image recognition for pest and disease detection.
Designed using **Spring Boot (Java)**, **MySQL**, and **AI microservices**, SCAS ensures scalability, usability, and offline accessibility through SQLite. The application further incorporates multilingual and voice-based support to overcome literacy barriers, along with WhatsApp alerts for timely updates. The system aims to promote sustainable agriculture, reduce input misuse, and enhance overall crop productivity — aligning with India's vision for digital and inclusive farming.

Contents

1. Executive Summary and Title

1.1 Title of the Project

Smart Crop Advisory System — An AI-Powered Multilingual Web Application for Intelligent Farming Support.

1.2 Executive Summary

The **Smart Crop Advisory System (SCAS)** is an AI-powered, multilingual web application designed to assist small and marginal farmers in making accurate, data-driven agricultural decisions. Traditional farming practices in India often rely on intuition or unverified advice from local dealers, leading to low yields, excessive input costs, and long-term soil degradation. SCAS addresses this gap by providing an intelligent, accessible, and regionally adaptive solution that integrates modern technology with local farming needs.

The system leverages **machine learning** and **deep learning algorithms** to offer personalized recommendations for **crop selection**, **fertilizer usage**, and **pest management**, based on real-time **soil data**, **weather patterns**, and **historical trends**. It incorporates **CNN-based image analysis** for pest and disease detection from farmer-uploaded images and uses **OpenWeather API** for predictive weather insights. To ensure inclusivity, the platform supports **multilingual and voice-based interaction**, enabling even low-literate farmers to access reliable advisory content easily.

Built using **Java Spring Boot** with a **microservices architecture**, the system ensures scalability, security, and seamless integration of modules such as the **AI chatbot**, **alert system**, and **blog section**. It utilizes **MySQL** for online data storage and **SQLite** for offline functionality, ensuring usability in low-network rural areas. Additionally, **WhatsApp alert integration** delivers real-time notifications about pest outbreaks and adverse weather conditions, further enhancing responsiveness and usability.

The project's four-week development plan encompasses requirement analysis, system design, backend and frontend implementation, AI model integration, testing, and deployment. Once deployed, the Smart Crop Advisory System is expected to significantly improve **crop productivity**, **reduce input misuse**, and **strengthen soil health** while promoting sustainable agricultural practices. By combining data science, AI, and regional language support, SCAS aims to democratize agricultural technology, empowering farmers to make informed, profitable, and environmentally responsible decisions — aligning with India's vision for a **digitally driven, sustainable agricultural future**.

2. Problem Statement

A majority of India's small and marginal farmers still depend on **guesswork** or **unverified local advice** from shopkeepers when making critical agricultural decisions regarding **crop selection**, **fertilizer usage**, and **pest control**.
This leads to:

- Ineffective farming practices,
- Excessive use of fertilizers and pesticides,
- Declining soil health, and
- Reduced agricultural productivity and income.

Without reliable data or expert guidance, farmers remain trapped in a cycle of low yields, high input costs, and environmental degradation.

3. Background of the Problem

According to **NABARD (2022)**, nearly **86% of Indian farmers** are classified as *small and marginal*, cultivating less than two hectares of land.
These farmers face multiple interconnected challenges:

- Poor crop planning and inefficient input management.
- Overuse/misuse of fertilizers and pesticides, leading to **soil degradation** and **water contamination**.
- Limited access to reliable **expert guidance** or scientific advisory services.
- **Language barriers** and **low digital literacy** that prevent them from benefiting from existing agri-tech tools and applications.

As a result, their livelihoods, income stability, and long-term sustainability remain vulnerable — calling for a **localized, intelligent, and inclusive digital solution**.

4. Proposed Solution

To tackle these challenges, we propose the **Smart Crop Advisory System (SCAS)** — an **AI-driven multilingual advisory web application** designed specifically for small and marginal farmers.

The system aims to provide **personalized, data-backed agricultural recommendations** through a simple, accessible interface and an interactive AI chatbot.

Key Features

1. **Smart Crop Selection:**
   Suggests the most suitable crops based on soil parameters, weather conditions, and previous crop history.
2. **Fertilizer and Soil Health Management:**
   Recommends optimal fertilizer usage based on soil reports and nutrient levels to avoid overuse.
3. **Real-Time Weather Alerts and Predictive Insights:**
   Integrates **OpenWeather API** to provide localized, real-time weather forecasts and early warnings.
4. **Pest and Disease Detection:**
   Farmers can upload images of affected crops. The system uses **CNN (Convolutional Neural Networks)** for image analysis and disease identification.
5. **Multilingual and Voice Support:**
   Enables farmers to interact in their **local language** through text or voice, breaking literacy barriers.
6. **Disease Outbreak Alerts:**
   Notifies nearby farmers about emerging pest or disease outbreaks using **WhatsApp notifications**.
7. **Blog & Knowledge Sharing Platform:**
   A dedicated blog section for **expert articles**, **agricultural best practices**, and **farmer experience sharing**.

5. Objectives

- To build an **AI-powered decision support system** for Indian farmers.
- To enhance **agricultural productivity** through data-driven insights.
- To minimize input wastage and **improve soil sustainability**.
- To make agri-tech **accessible and inclusive** via multilingual and voice-based support.
- To promote **knowledge sharing** and **community-based learning** among farmers.

6. Literature Review

6.1 Summary of Existing Solutions

Existing agricultural advisory platforms such as Kisan Suvidha, eNAM, and AgroStar provide limited advisory features, mostly restricted to static weather or market information. Few AI-based models exist that combine crop prediction, fertilizer management, and pest diagnosis in one ecosystem. Moreover, most solutions lack regional language support and real-time personalized recommendations.

6.2 Identification of Research Gaps

- Absence of a **unified intelligent system** integrating weather, soil, and pest data.
- Limited inclusion of **AI/ML-based predictive analysis** for localized conditions.
- Lack of **multilingual and voice-enabled interfaces** for low-literacy users.
- Minimal adoption of **real-time alert mechanisms** for disease or weather threats.
- The SCAS project addresses these research gaps through modular AI integration, localized dataset training, and inclusive communication features.

7. Approach and Methodology

7.1 System Architecture

The Smart Crop Advisory System will be developed as a **Java Spring Boot** web application using **microservices architecture** for modularity and scalability.

7.1.1 Technology Stack

- **Backend:** Spring Boot, Spring Data JPA, Spring Security
- **Frontend:** HTML, CSS, JavaScript, AJAX
- **Database:**
    - **Online:** MySQL (for cloud storage and remote access)
    - **Offline:** SQLite (for low-connectivity environments)
- **APIs:**
    - **Weather Data:** OpenWeather API for forecasts and predictive analytics
    - **Fertilizer & Crop Data:** Kaggle/open agricultural datasets

7.1.2 AI & ML Components

- **Crop Recommendation Model:** Trained using historical soil and yield data with **Machine Learning algorithms**.
- **Fertilizer Optimization:** Regression and classification-based models for precise dosage calculation.
- **Pest/Disease Detection:** Implemented using **Deep Learning (CNN)** for analyzing uploaded crop images.
- **Multilingual Chatbot:** NLP-based AI chatbot integrated with **translation APIs** and **text-to-speech tools** for voice support.

7.1.3 Notification System

- **WhatsApp Alerts:** Spring Boot backend triggers automated alerts for disease outbreaks and severe weather events.

7.1.3 Blog Page Implementation

- Developed using **Spring Boot**, **JavaScript**, and **MySQL** database.
- Supports CRUD operations and real-time updates using **AJAX**.

7.2 Work Breakdown Structure (WBS)

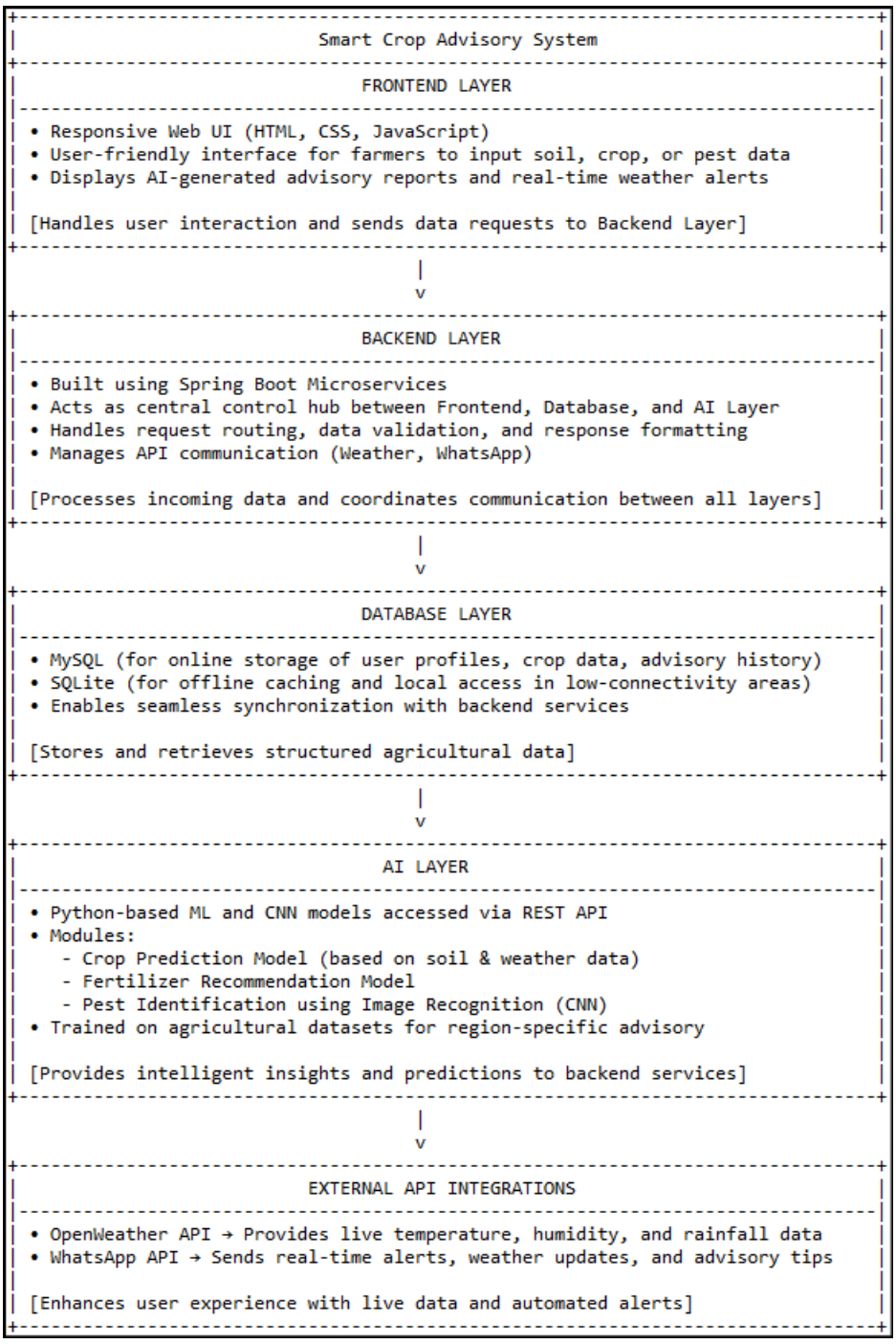
Phase	Task	Description
1. Planning	Problem study & requirement analysis	Identify key functional and non-functional requirements
2. Design	System architecture, database, and UI design	Create ERD, UML, and UI mockups
3. Development (Backend)	Spring Boot microservices	Implement modules for chatbot, alerts, and data analytics
4. Development (Frontend)	Responsive web UI	Build HTML/CSS/JS interface with localization support
5. AI Model Development	Data preprocessing, model training	Train ML models for crop/fertilizer/disease prediction
6. Integration	Connect backend, AI models, and APIs	Integrate OpenWeather, database, and chatbot
7. Testing & Deployment	Unit, integration, and user testing	Validate accuracy, reliability, and usability
8. Documentation & Report	Final report, user manual	Prepare project synopsis and demo documentation

7.3 Gantt Chart

Week	Tasks	Details / Deliverables
Week 1	Requirement Analysis & System Design	Finalize project scope, create architecture diagrams, collect datasets (soil, crop, fertilizer, pest).
Week 2	Backend & Frontend Development	Develop Spring Boot services, MySQL database, and responsive frontend with HTML/CSS/JS.
Week 3	AI Integration & API Connectivity	Implement ML models for crop prediction and fertilizer recommendation, integrate CNN for image recognition, connect OpenWeather API and chatbot.
Week 4	Testing, Optimization & Deployment	Conduct functional and user testing, fix bugs, integrate WhatsApp alerts, deploy and prepare documentation.

8. System Architecture

8.1 Block Diagram



8.2 Explanation of Components

- **User Interface Module:** Allows farmers to enter queries, upload crop images, and receive results.
- **AI Engine:** Performs crop recommendation, fertilizer optimization, and pest identification.
- **Database Manager:** Stores user, crop, and advisory data efficiently.
- **Notification System:** Sends WhatsApp or SMS alerts for weather or pest risks.
- **Security Module:** Uses Spring Security and encrypted credentials for user privacy.

9. Module Description

9.1 Breakdown of the Project

i. **User Module** – Handles registration, login, and multilingual access.
ii. **Crop Recommendation Module** – Suggests best crops using soil and weather parameters.
iii. **Fertilizer Advisory Module** – Optimizes fertilizer dosage through regression-based prediction.
iv. **Pest Detection Module** – Uses CNN to classify pest images.
v. **Weather Forecast Module** – Displays current and forecasted weather data from OpenWeather API.
vi. **Notification & Alert Module** – Sends WhatsApp notifications to users.
vii. **Blog & Community Module** – Enables farmers and experts to share insights and best practices.

9.2 Explanation of Module Functionality

Each module interacts through REST APIs within the Spring Boot framework, maintaining modularity and scalability. The AI modules are designed as independent Python microservices for seamless updates and retraining. Data synchronization between MySQL (online) and SQLite (offline) ensures accessibility even in rural areas with poor connectivity.

10. Expected Outcomes

Upon successful implementation, the Smart Crop Advisory System will:

- Enhance **crop yield** and **farm income** through AI-driven advisory.
- Reduce **input costs** by optimizing fertilizer and pesticide usage.
- Improve **soil health** and promote **sustainable agriculture**.
- Increase **accessibility** for small farmers via multilingual and voice-enabled support.
- Enable **community-based knowledge sharing** through the blog portal.
- Support India's **Digital Agriculture Mission** by bringing AI and data analytics to grassroots-level farming.

11. Future Scope

11.1 Possible Enhancements and Extensions

- Integration of **satellite and IoT-based soil sensors** for real-time data collection.
- Mobile application version for Android devices.
- AI-driven **yield prediction and market price forecasting**.
- **Blockchain-based supply chain tracking** for transparency in produce distribution.
- Integration with **government agricultural databases** for verified datasets.

11.2 Industrial or Research Applications

- Can assist **agriculture departments** and NGOs in policy formation and resource allocation.
- Useful for **academic research** in precision agriculture and data analytics.
- Commercially adaptable for **agro-tech startups** providing farm advisory services.
- Potential for collaboration with **Krishi Vigyan Kendras** for real-world deployment.

12. Reference

- National Bank for Agriculture and Rural Development (NABARD) Report 2022.
- Government of India, *Digital Agriculture Mission 2021–2025.*
- OpenWeather API Documentation – https://openweathermap.org/api
- Kaggle Agricultural Datasets – Soil, Fertilizer, Crop Yield.
- "Precision Agriculture Using Machine Learning," *IEEE Transactions on AgriTech*, 2022.
- TensorFlow Documentation – https://www.tensorflow.org
- Spring Boot Reference Documentation – https://spring.io/projects/spring-boot
- "AI-based Crop Disease Prediction," *Elsevier Journal of Smart Agriculture*, 2023.