AI - BASED SMART FARMING

Minor project-1 report submitted
in partial fulfillment of the requirement for award of the degree of

Bachelor of Technology
in
Computer Science & Engineering

By

GURTHURTHI ESHWAR PRASAD	(22UEID0045)	**(VTU 21447)**
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Under the guidance of
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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
SCHOOL OF COMPUTING

VEL TECH RANGARAJAN DR. SAGUNTHALA R&D INSTITUTE OF SCIENCE & TECHNOLOGY

(Deemed to be University Estd u/s 3 of UGC Act, 1956)
Accredited by NAAC with A++ Grade
CHENNAI 600 062, TAMILNADU, INDIA

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CERTIFICATE

It is certified that the work contained in the project report titled ”AI BASED SMART FARMING” by ”GURTHURTHI ESHWAR PRASAD (22UEID0045), GADDE VIJITHA (22UECM0084), MEDIKONDURU CHARAN SAI (22UECM0169)” has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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December, 2024

DECLARATION

We declare that this written submission represents my ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Date: / /

APPROVAL SHEET

This project report entitled AI - BASED SMART FARMING by GURTHURTHI ESHWAR PRASAD (22UEID0045), GADDE VIJITHA (22UECM0084), MEDIKONDURU CHARANSAI (22UECM-0169) is approved for the degree of B.Tech in Computer Science & Engineering.

Examiners **Supervisor**

Dr. N. RAJKUMAR,Ph.D.,

Date: / /

Place:

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We express our deepest gratitude to our **Honorable Founder Chancellor and President Col. Prof. Dr. R. RANGARAJAN B.E. (Electrical), B.E. (Mechanical), M.S (Automobile), D.Sc., and Foundress President Dr. R. SAGUNTHALA RANGARAJAN M.B.B.S.** Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, for her blessings.

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ABSTRACT

AI-Based Smart Farming utilizes artificial intelligence technology to optimize agricultural practices.It involves the use of sensors, drones, and data analytics to monitor and manage crops more efficiently.AI algorithms can analyze data on weather conditions, soil health, and crop growth to provide real time insights for farmers. This technology helps farmers make data-driven decisions to improve crop yield, reduce costs, and minimize environmental impact.Enhancing agricultural productivity by optimizing resource usage and crop management. Improving sustainability by reducing environmental impact through precise and efficient farming practices.Empowering farmers with data-driven insights for better decision-making and increased yields.Increasing operational efficiency by automating tasks such as irrigation, fertilization, and pest control. Enabling predictive maintenance to identify potential issues early and prevent crop losses. Facilitating remote monitoring and management of farms, providing real-time insights for proactive decision-making.Implementing automation technologies such as drones and smart equipment to carry out tasks like irrigation and monitoring. Using sensors to collect data on soil health, weather conditions, and crop growth. computer vision technology to identify plant diseases and pests for targeted treatment. Incorporating machine learning models to predict crop yields and optimize planting schedules. Integrating IoT devices to create a connected farm ecosystem for seamless data exchange and control.The project successfully increase the crop yields and quality due to optimized resource management and proactive decision making.Reduced operational costs through efficient use of resources and automation of farming processes.Improved sustainability by minimizing environmental impact and promoting ecofriendly farming practices. Enhanced decision-making capabilities leading to better crop management and disease prevention.Increased efficiency in resource utilization such as water and fertilizers. Facilitation of precision agriculture techniques resulting in more targeted and effective farming practices.

Keywords:

Automation, Precision Agriculture, IoT, Machine Learning, Crop Monitoring, Predictive Analytics, Autonomous Machinery, Drones, Irrigation Systems, Livestock Management,

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LIST OF ACRONYMS AND ABBREVIATIONS

API	Application Programming Interface
CSS	Cascading Style Sheets
DBMS	Database Management System
GCP	Google Cloud Platform
HTML	HyperText Markup Language
JS	JavaScript
JSON	JavaScript Object Notation
UI	User Interface
URL	Uniform Resource Locator
SQL	Structured Query Language
SMTP	Simple Mail Transfer Protocol

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Chapter 1

INTRODUCTION

1.1 Introduction

Smart farming applies information technologies for the optimization of complex farming systems. It incorporates information and communication technologies to improve agriculture production system. The agricultural sector is one of the most important production sectors. It is concerned with all aspects of agricultural activities and is divided into the four major subsectors of crops, forestry, livestock (production and animal health), and aquaculture. AI encompasses a broad range of applications in the field of computer science related to the possibility of building smart machines, robots, or sensors that are capable of simulating human actions to achieve tasks on behalf of humans to serve society intelligently. These actions are controlled by application programs using information technology devices. Combining AI approaches and traditional agricultural methods, smart agriculture is being used to improve national economies by monitoring crop growth using the principles of precision farming. With these strategies, together with the help of machine learning, the IoT, and cloud computing, all environmental features can be monitored to choose the best environment for each type of crop through the classification of the gathered data using one of the available classification techniques.

IoT is a system of interrelated physical devices or objects with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks without requiring human-to-computer or human-to-human interaction. Smart irrigation is another new technique in agriculture to help farmers in automating irrigation processes by collecting data using smart devices such as Raspberry Pi. The collected data are then analyzed to select the best technique for switching the flow of water on the farm to the ON or OFF state. Therefore, smart irrigation system provides the agriculture sector and farmers with many benefits such as: Cost savings due to minimized water waste,Reduced human efforts,A unified view of soil characteristics, including moisture and nutrient contents,Smart notifications in case of abnormalities,Better long-term landscape health,IoT ecosystem for smart irrigation. AI and machine learning can be used to monitor crops.

1.2 Aim of the project

The project seeks To empower individuals with the foundational skills and knowledge necessary for personal development, Socio-economic, advancement and active participation in their communities. Enhancing crop productivity and quality through the implementation of AI technologies.Improving resource efficiency by optimizing the use of water, fertilizers, and other inputs. Empowering farmers with data-driven insights for informed decision-making and sustainable agricultural practices.

1.3 Project Domain

AI-based smart farming revolves around enhancing agricultural productivity, sustainability, and resource management through advanced technologies. By integrating artificial intelligence, machine learning, and IoT , smart farming enables precision agriculture, where data from sensors, drones, and satellite imagery help monitor soil conditions, weather patterns, crop health, and irrigation needs. AI algorithms analyze this data to optimize planting schedules, nutrient application, and pest control, reducing waste and improving yields.

The system can automate tasks such as watering, fertilizing, and even harvesting, enhancing efficiency and reducing labor costs. AI-driven predictive analytics can also forecast crop diseases and market trends, aiding farmers in making informed decisions. This domain aims to address global challenges like food security, climate change, and resource conservation by making farming more intelligent, data-driven, and responsive to environmental changes, ultimately increasing productivity while minimizing ecological impact.

1.4 Scope of the Project

The scope of an AI-based smart farming project encompasses various aspects of agricultural operations, targeting improvements in efficiency, sustainability, and productivity. It includes the development and integration of AI technologies such as machine learning models, computer vision, and predictive analytics into farming practices. Key areas of application involve precision agriculture, where AI-driven data analysis helps optimize irrigation, fertilizer usage, and pest management, minimizing waste and maximizing crop yields.

The project scope also extends to automating routine tasks like planting, watering, and harvesting through robotics and IoT devices, reducing labor requirements and enhancing operational efficiency. Another crucial area is predictive modeling, where AI forecasts weather patterns, crop diseases, and market demand, allowing farmers to make proactive decisions. Furthermore, it includes research on sustainable practices and how AI can be leveraged to mitigate the environmental impact of farming, contributing to climate resilience and resource conservation. The ultimate goal is to create a holistic, data-driven agricultural system.

Chapter 2

LITERATURE REVIEW

2.1 Literature Review

[1] G R Poornima et al., proposed a solution to increase the crop production and control the agricultural cost of the products using this predicted information. IoT device is used to sense the agricultural data and it is stored into the Cloud database. Cloud based Big data analysis is used to analyze the data viz. fertilizer requirements, analysis the crops, market and stock requirements for the crop. Then the prediction is performed based on data mining technique which information reaches the farmer via mobile app. Smart or precision agricultural systems are estimated to play an essential role in improving agriculture activities. Mobile device usage is very common by everyone, including the farmers.

[2] Shwetha Rokhade et al., proposed the solution for improving quality of Crop by controlling environmental parameters and proper aggregation of soil. The complicated process such as monitoring the environmental parameters such as humidity, temperature and rain also with the health of the crop. All these operations are achieved by using Arduino aided IoT, image processing technique and smart sensors. The system also helps the farmer with real-time data with a simple cloud interface implemented by Rest API. The overall goal of the innovation is to provide an effective technological solution to the field of agriculture at the same time being cost-effective and easy to maintain.

[3] Tuan Dinh Le et al., describes the design, implementation, and deployment of wireless sensor network for precision agriculture. The collected data is stored and transmitted wirelessly to the farmers, which they can use to control and decide appropriate actions for their farm to manage the production and quality. Our experimental results show that the data prediction module with dynamic Bayesian network on average can achieve 77.5. 11.

[4] Narendra Kumar et al., Described an overview of the function of image processing in the field of the Internet of Things. In this paper, we have used the ESP32 CAM WiFi Module with OV2640 Camera Module and the Arduino Uno R3 that open- source microcontroller board. We capture the plant image and use the cloud and big data-based prediction model for data analysis. We have used the Thing Speak opensource platform to show the camera Received Signal Strength. Image processing and IoT technology use various sensors and camera-based sensors for processing image data with help of a variety of IoT applications. So far, the IoT and image processing concepts have been used for our real-life applications. Their individual use in the sphere of industries is possible and has had some success. By conducting a thorough background study using a combination of research methods and data sources, a comprehensive understanding of the issues facing Village jadcherla was developed. This knowledge serves as a valuable foundation for designing targeted interventions and community development programs aimed at addressing the identified challenges and fostering positive change.

[5] K. Balamurugan et al., IoT is present and future of every field impacting everyone's life. The new developments of Smart Farming with use of IoT, by day turning the face of conventional agriculture methods by not only making it optimal but also making it cost efficient for farmers and reducing crop wastage. The aim is to propose a technology which can generate messages on different platforms to notify farmers. The product will assist farmers by getting live data (Temperature, humidity, soil moisture, UV index, IR) from the farmland to take necessary steps to enable them to do smart farming by also increasing their crop yields and saving resources (water, fertilizers). The product proposed in this paper uses ESP32s Node MCU, breadboard, DHT11 Temperature and Humidity Sensor, Soil Moisture Sensor, SI1145 Digital UV Index / IR / Visible Light Sensor, Jumper wires, LEDs and live data feed can be monitored on serial monitor. This will allow farmer to manage their crop with new age in farming.

[6] K. Rajesh et al., One of the most critical applications of AI in agriculture is weather forecasting. With changing climates and increasing pollution, farmers can struggle to determine the right time to sow seeds. By using AI-powered weather forecasting systems, farmers can analyze real-time weather data.

[7]Shaik Shakeel Ahamad et al., Agricultural IOT has brought new changes to agricultural production. It not only increases agricultural output but can also effectively improve the quality of agricultural products, reduce labor costs, increase farmers' income, and truly realize agricultural modernization and intelligence. This paper systematically summarizes the research status of agricultural IoT.

[8] Tim Sandle Forbes et al., Using drones for fertiliser spraying, is now a nobrainer agritech solution for many Indian farmers. In recent years, state governments, startups and educational institutions across the country have started offering rental schemes and training programmes for farmers to use agriculture drones for pesticide spraying. The central government has also announced subsidies for farmers who wish to purchase agri drones.

[9] Alireza Alhmad et al., Smart farming with artificial intelligence provides an efficient solution to today's agricultural sustainability challenges. Machine learning, Deep learning, and time series analysis are essential in smart farming. Crop selection, crop yield prediction, soil compatibility classification, water management, and many other processes are involved in agriculture. Machine learning algorithms are used for crop selection and management, Deep learning techniques are used for crop selection and forecasting crop production, and time series analysis is used for demand forecasting of crops, commodity price prediction, and crop yield production forecasting. Crops are chosen using machine learning algorithms and deep learning algorithms based on soil, soil compatibility classification, and other factors. In the agriculture industry, this article offers a thorough review of machine learning and deep learning techniques. Crop data sets can be used to classify soil fertility, crop selection, and many other aspects using machine learning algorithms.

Chapter 3

PROJECT DESCRIPTION

3.1 Existing System

Existing AI-based smart farming systems utilize advanced technologies such as IoT, machine learning, and robotics to improve agricultural efficiency and sustainability. Precision agriculture platforms, like John Deere's FarmSight and Trimble Agriculture, use AI to optimize planting, irrigation, and fertilization by analyzing real-time data from sensors monitoring soil, weather, and crop health. Automated irrigation systems like CropX and Netafim adjust water usage based on soil moisture data, ensuring efficient resource use.

AI-powered crop monitoring systems, such as AgroScout and Prospera, employ drones and computer vision to detect diseases, pests, and nutrient deficiencies, enabling early intervention. Farm management platforms like Climate FieldView provide farmers with real-time insights and predictive analytics to improve decision-making and crop yields. Additionally, autonomous machinery like Blue River Technology's "See Spray" uses AI to precisely apply herbicides, reducing chemical waste. These systems help optimize inputs, lower costs, and enhance farm productivity.

Disadvantages of existing system:

1.High Initial Costs
2.Technical Complexity
3.Data Dependency and Accuracy
4.Limited Scalability
5.Privacy and Data Security Concerns

3.2 Problem statement

The problem statement for AI-based smart farming addresses the growing challenges in modern agriculture, such as increasing food demand, resource constraints, and environmental sustainability. Traditional farming methods often result in inefficient use of water, fertilizers, and pesticides, leading to waste, reduced crop yields, and environmental degradation. Farmers also face unpredictable weather patterns and climate change, which further complicate decision-making and crop management.

The limited access to real-time, data-driven insights hampers farmers' ability to optimize resource use and improve productivity. Additionally, small-scale farmers, especially in developing regions, struggle with adopting advanced technologies due to high costs and technical complexities. The lack of precise monitoring systems makes it difficult to detect early signs of pests, diseases, or nutrient deficiencies, resulting in preventable crop losses.

By labor shortages and the growing global population, which puts additional pressure on agricultural systems to produce more food with fewer resources. The inability to predict market trends and demand adds further risk to farmers' livelihoods. As a result, there is a pressing need for intelligent solutions that leverage AI, IoT, and data analytics to make farming more efficient, sustainable, and scalable. Addressing these issues through AI-based smart farming can enhance decision-making, reduce waste, and ensure better crop management, particularly benefiting smallholders by providing affordable, user-friendly technologies.

Advantages of Proposed system:

1.Increased Crop Yields
2.Cost Reduction
3.Sustainability
4.Early Detection of Problems
5.Remote Monitoring

3.3 System Specification

3.3.1 Hardware Specification

Hardware Component	**Specifications**	**Description**
Soil moisture sensor	Capacitive soil moisture sensor	Measures soil moisture to automate irrigation systems
Temperature sensor	DHT22 / SHT31	Monitors temperature for climate control in greenhouses
Humidity sensor	DHT22 / SHT31	Monitors humidity for environment regulation
pH Sensor	Analog pH sensor with probe	Tracks soil PH to ensure suitable crop growth conditions
Nutrient sensor	TDS meter or NPK sensor	Measures soil or water nutrient levels (Total Dissolved solids, Nitrogen, Phosphorus, Potassium)
Camera (for vision)	1080p HD 4K camera (RGB or Multispectral)	for plant health monitoring,disease detection using computer vision
Thermal camera	FLIR Lepton or seek Thermal compact	Detects heat stress in plants or animals
Drones	DJI Phantom 4 multispectral drone	used for large area crop monitoring, soil analysis, and mapping
Actuators(irrigation)	Motorized valves / solenoid valves	Automatically controls water flow in irrigation systems
Robots/Smart Tractors	Autonomous farming robots(e.g., FarmBot, AgriRobot)	For planting, weeding, and harvesting
Microcontroller	Arduino mega / ESP32	For sensor integration and control of devices

Table 3.1: Hardware Specifications

3.3.2 Software Specification

Software Component	Specifications	Description
Operating System (OS)	Linux (Ubuntu, Debian), Windows 10/11	The underlying system environment for managing devices and running AI models. Linux is preferred for its stability and compatibility with AI tools.
AI Frameworks	TensorFlow, PyTorch, Scikit-learn	For building and training AI models used in crop health monitoring, yield prediction, and automation tasks.
IoT Platform	Node-RED, ThingsBoard, OpenHAB	For integrating and managing IoT devices (sensors, cameras, actuators) on the farm and automating workflows.
Cloud Platforms	AWS, Google Cloud, Microsoft Azure	For data storage, large-scale AI model training, and running farm management applications in the cloud.
Database Systems	MySQL, PostgreSQL, MongoDB	For storing sensor data, environmental readings, crop history, and AI model results.
Computer Vision Libraries	OpenCV, Keras (with TensorFlow backend)	Used for image analysis in plant disease detection, crop monitoring, and other vision-based AI tasks.
Communication Protocols	MQTT, HTTP, LoRaWAN	Enables communication between sensors, edge devices, and central servers to ensure real-time data flow.
Edge Computing Software	Kubernetes, Docker (for Edge AI)	Manages containerized AI applications on edge devices like Raspberry Pi or NVIDIA Jetson to handle real-time processing locally.
Automation Software	OpenAgToolkit, FarmBot Software	Used for automating farming tasks such as planting, watering, and weeding based on AI or sensor data inputs.
Data Analytics Tools	Jupyter Notebooks, Pandas, Matplotlib	For data analysis and visualization, helping farmers make data-driven decisions based on historical and real-time sensor data.

Table 3.2: Software Specifications

Chapter 4

METHODOLOGY

4.1 Proposed System

The proposed AI-based smart farming system leverages advanced technologies to optimize agricultural processes. It integrates machine learning algorithms, IoT sensors, and real-time data analytics to monitor crop health, soil conditions, weather patterns, and water usage. Sensors embedded in the fields gather data on moisture levels, temperature, and nutrient content, which is analyzed by AI models to predict crop growth, detect diseases, and recommend optimal irrigation, fertilization, and harvesting schedules. Drones equipped with AI-powered cameras provide aerial monitoring, identifying potential issues early, such as pest infestations or water stress.

The system automates decision-making, allowing farmers to improve yields while minimizing resource usage, reducing waste, and promoting sustainable practices. Machine learning models continuously learn from historical data, enhancing accuracy over time. This smart farming approach aims to increase productivity, reduce labor costs, and ensure better environmental management, ultimately leading to more efficient and profitable agricultural practices.

AI-driven predictive analytics help farmers plan for future seasons by forecasting weather trends, market demands, and potential risks. Automated machinery, such as smart tractors and robotic harvesters, can be integrated to handle labor-intensive tasks, further enhancing farm efficiency. By leveraging big data and AI, this system fosters precision agriculture, reducing environmental impact while maximizing output and profitability. Farmers can make data-driven decisions, ensuring sustainable farming practices, conserving resources like water and fertilizers, and enhancing overall food security. This comprehensive approach ensures the future of agriculture is smarter, more efficient, and eco-friendly.

4.2 General Architecture

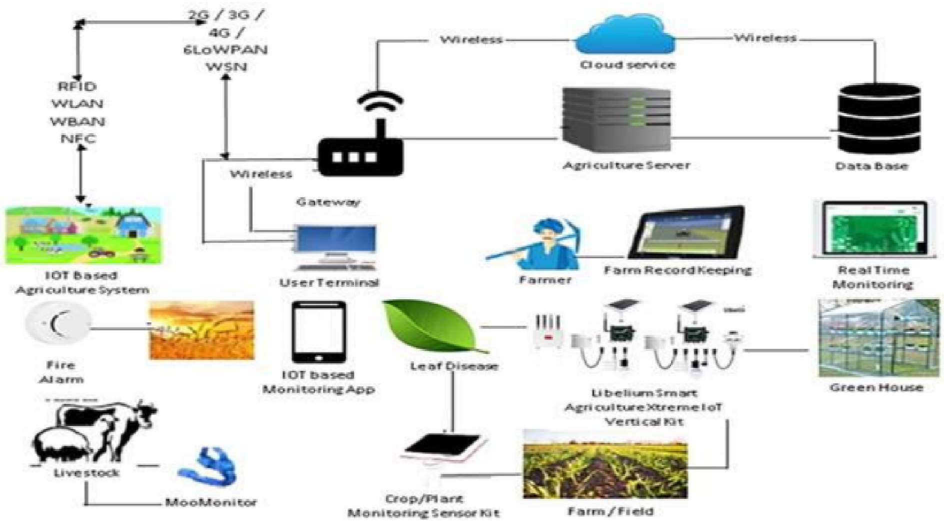


Figure 4.1: **System Architecture Diagram**

Description:

Utilize sensors and IoT devices to gather data on weather, soil conditions, and crop health.Transmit the collected data to a central system or cloud for processing. Use AI algorithms to analyze the data and extract valuable insights for decision-making. Implement AI-driven decision-making processes for crop management, resource optimization, and pest control. Integrate automation and robotics for tasks like planting, irrigation, and harvesting based on AI recommendations. Develop systems for remote monitoring and control of farming operations using AI-powered platforms. Establish feedback loop to continuously improve algorithms and decision-making based on real-time data

4.3 Design Phase

4.3.1 Data Flow Diagram

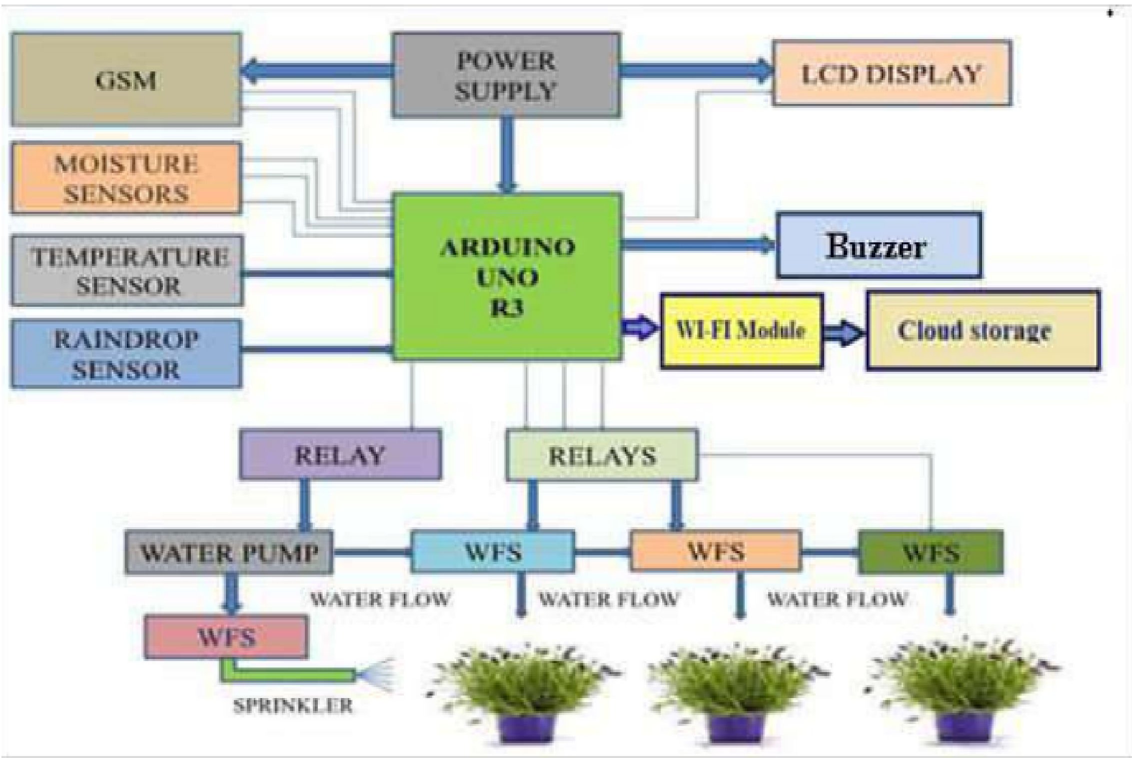


Figure 4.2: **Data Flow Daigram**

Description:

Automated irrigation system using Arduino and sensors. Sensors collect data on soil moisture, temperature, and rainfall. The Arduino Uno R3 board processes the sensor data. Based on the processed data, the Arduino determines if irrigation is needed. If irrigation is needed, the Arduino activates relays to control the water pump and sprinklers. The system can be monitored and controlled remotely via a GSM module, Wi-Fi module, and cloud storage, allowing for real-time adjustments and data analysis.

4.3.2 Use Case Diagram

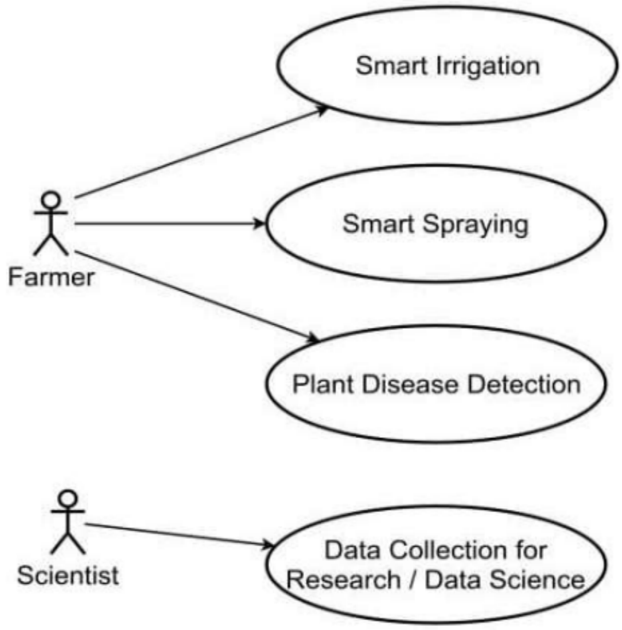


Figure 4.3: **Use Case Daigaram**

Description:

AI-based smart farming illustrates the interactions between different actors and system functionalities. Key actors include the Farmer, AI System, Sensors, Drones, and the Automated Irrigation System. The Farmer monitors and manages the system via a user interface, receiving real-time Notifications and Alerts based on critical farm conditions. Sensors collect data on soil moisture, temperature, and humidity, which is analyzed by the AI System to make decisions, such as when to activate the Irrigation System. Drones are used for aerial crop monitoring, while external data from Weather Services further informs the AI's decision-making.Use cases include Monitor Farm Data, Analyze Crop Health, Irrigation Control, Drone Surveillance, and Fertilizer Management. This diagram emphasizes automation, real-time data processing, and proactive farming decisions, with the farmer having oversight and control through alerts and a user interface.

4.3.3 Class Diagram

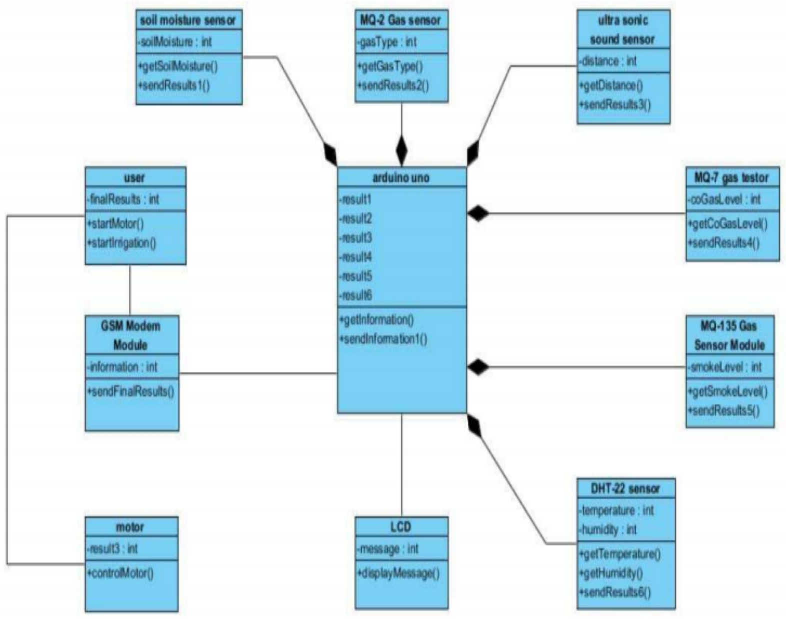


Figure 4.4: **Class Diagram**

Description:

AI-based smart farming provides a visual representation of the system's structure, showing the various classes, attributes, methods, and relationships. Key classes include:

Farmer: Contains attributes such as ID, name, and contact details. Methods include monitoring farm status and controlling systems manually.

Sensor: Represents different types of sensors (e.g., soil moisture, temperature, humidity). Attributes include sensor ID, type, and location. Methods focus on data collection.

AI System: Acts as the decision-making core, with attributes like processing power, machine learning models, and data storage. Methods include analyzing sensor data, predicting crop needs, and sending control commands.

Drone: Attributes include flight range, camera type, and payload capacity. Methods are related to aerial surveillance and crop monitoring.

Irrigation System: Includes attributes for water flow rate and soil conditions, with methods for automated irrigation control.

4.3.4 Sequence Diagram

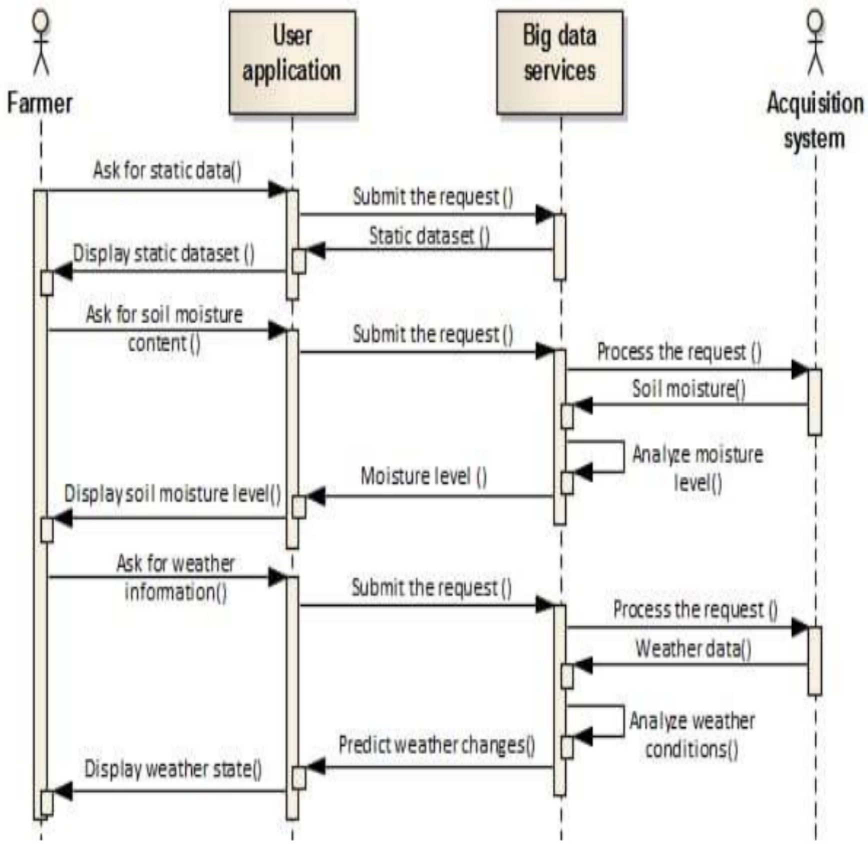


Figure 4.5: **Sequence Diagram**

Description:

In an AI-based smart farming system, the sequence begins when a Farmer requests farm data via a Mobile App or dashboard. IoT Sensors (monitoring soil moisture, temperature, and crop health) and Drones collect real-time data from the field. This data is sent to the AI Model, which processes it using machine learning algorithms to predict irrigation needs, pest risks, and crop health.The AI Model then sends recommendations to the Farm Management System, triggering actions such as adjusting water levels through the Smart Irrigation System or deploying fertilizers. Simultaneously, the Farmer receives real-time notifications and insights through the app.The system continuously learns from data feedback (like crop growth and weather changes) to refine its future predictions. This adaptive system optimizes resource use, improves crop yield, and reduces labor, making smart farming a highly efficient solution for modern agriculture.

4.3.5 Collaboration diagram

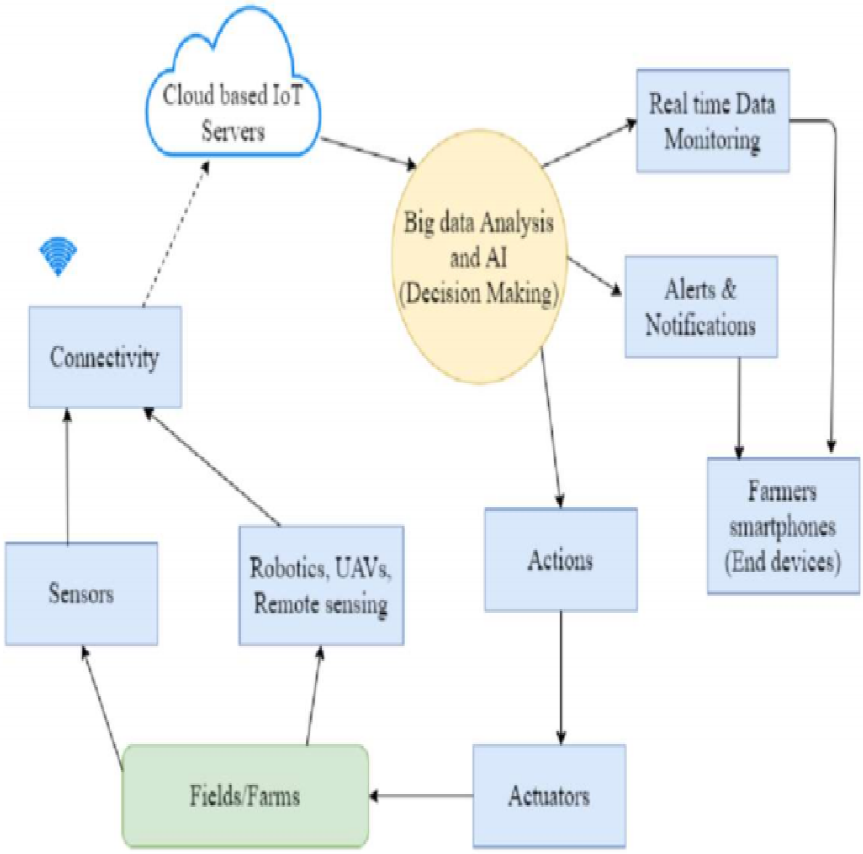


Figure 4.6: **Collaboration diagram**

Description:

A collaboration diagram for AI-based smart farming illustrates interactions between key components in the system: **Farmer:** The Farmer uses a Mobile App or Farm Management Dashboard to request information and receive actionable insights.

IoT Sensors: Soil Sensors, Weather Stations, and Drones gather real-time data on soil conditions, temperature, and crop health, transmitting this information to the Data Aggregation System.

Data Aggregation System: This component consolidates data from various sensors and forwards it to the AI Model for analysis.

AI Model: The AI Model processes the collected data, generating recommendations for irrigation, fertilization, and pest control. It communicates these insights to the Farm Automation System.

Farm Automation System: This system executes tasks based on AI recommenda-

tions, adjusting irrigation levels or deploying fertilizers as needed.
Feedback Loop: The system provides updates to the Farmer, who can offer input, enhancing the AI's future decision-making.

4.3.6 Activity Diagram

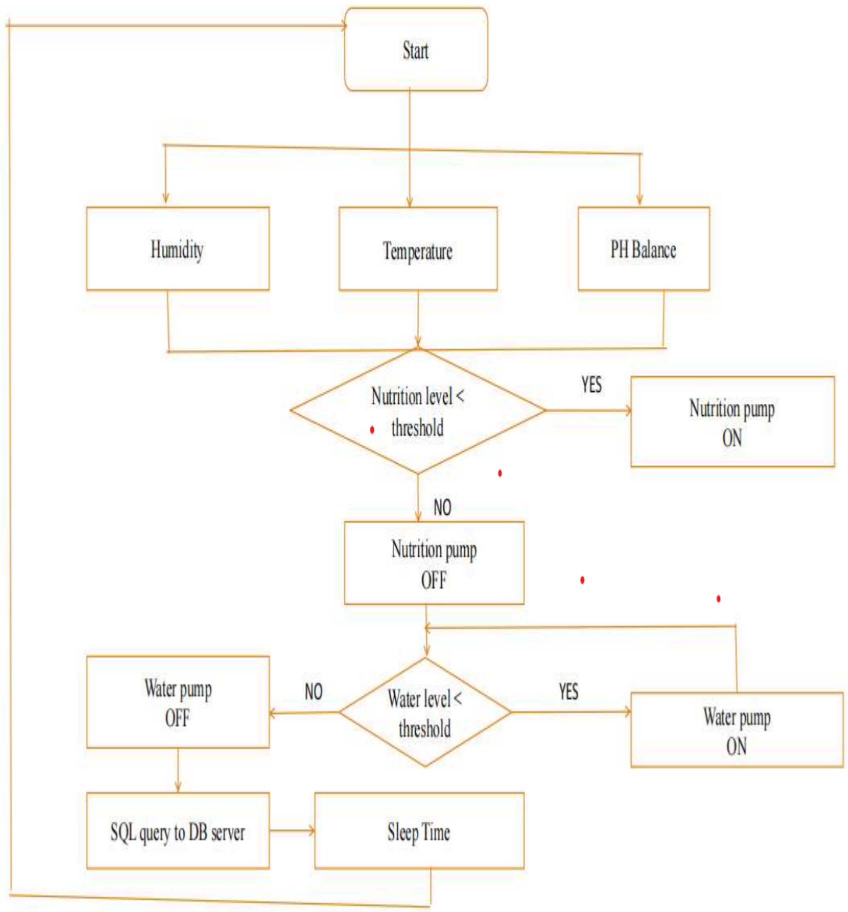


Figure 4.7: **Acitivity Diagram**

4.4 Algorithm & Pseudo Code

4.4.1 Algorithm

COMPUTER VISION ALGORITHM

Computer vision algorithms are integral to AI-based smart farming, enabling various advanced functionalities that help in optimizing agricultural practices, improving crop health, and increasing yields. Here show computer vision is used in smart farming:

1. Plant Disease Detection:

- Image Classification: Computer vision can analyze images of plants to detect diseases. Using deep learning models like Convolutional Neural Networks (CNNs), the system can classify and identify diseases from images of leaves, stems, or fruits.
- Real-time Monitoring: Cameras placed in the field can continuously monitor plants. When a disease is detected, the system can alert farmers, allowing for early intervention and reducing crop loss.

2. Weed Detection and Removal:

- Object Detection: Computer vision algorithms can distinguish between crops and weeds in a field. This information can be used to guide automated weeding machines or drones to target and remove weeds without harming the crops.
- Precision Spraying: Instead of spraying herbicides over an entire field, computer vision can help in applying them only where weeds are detected, reducing chemical usage and costs.

3. Crop Monitoring and Yield Prediction:

- Growth Stage Analysis: By analyzing images taken over time, computer vision can track the growth stages of crops, helping farmers make decisions on irrigation, fertilization, and harvest timing.
- Yield Estimation: Algorithms can estimate crop yield by counting the number of fruits or plants in an image. This helps in planning for harvest and market supply.

4. Soil and Water Management:

- Soil Condition Monitoring: High-resolution images of the soil can be analyzed to detect moisture levels, erosion, and nutrient deficiencies. This information can be used to optimize irrigation schedules and fertilization.
- Flood and Drought Detection: Drones equipped with cameras can fly over large areas to monitor water distribution. Computer vision can detect signs of drought or overwatering, enabling corrective actions.

5. Pest Detection and Management:

- Pest Identification: Computer vision can identify pests on plants by analyzing their images. This helps in early detection and targeted pest control, minimizing the damage to crops.
- Automated Traps and Repellents: Systems equipped with computer vision can activate traps or repellents when pests are detected in specific areas.

4.4.2 Pseudo Code

```
    <!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width,
 initial-scale=1.0">
    <title>AI-Based Smart Farming Login</title>
    <style>
        body {
            font-family: Arial, sans-serif;
            background-color: #f2f2f2;
            display: flex;
            justify-content: center;
            align-items: center;
            height: 100vh;
            margin: 0;
        }
        .login-container {
            background-color: #fff;
            padding: 20px;
            border-radius: 8px;
            box-shadow: 0 0 10px rgba(0, 0, 0, 0.1);
            width: 300px;
            text-align: center;
        }
        .login-container h1 {
            margin-bottom: 20px;
        }
        .login-container input[type="text"],
        .login-container input[type="password"] {
            width: 100%;
            padding: 10px;
            margin: 10px 0;
            border: 1px solid #ccc;
            border-radius: 4px;
        }
        .login-container input[type="submit"] {
            background-color: #28a745;
            color: white;
```

```
            padding: 10px;
            width: 100%;
            border: none;
            border-radius: 4px;
            cursor: pointer;
            font-size: 16px;
        }
        .login-container input[type="submit"]:hover {
            background-color: #218838;
        }
        .login-container p {
            margin-top: 20px;
            font-size: 14px;
        }
        .login-container a {
            color: #007bff;
            text-decoration: none;
        }
        .login-container a:hover {
            text-decoration: underline;
        }
    </style>
</head>
<body>
    <div class="login-container">
        <h1>Smart Farming Login</h1>
        <form action="/dashboard" method="post">
            <input type="text" name="username"
            placeholder="Username" required>
            <input type="password" name="password"
            placeholder="Password" required>
            <input type="submit" value="Login">
        </form>
        <p>New user? <a href="/register">Register here
        </a></p>
        <p>Or, use AI to analyze your farm images
        after login!</p>
    </div>
</body>
</html>
```

4.4.3 Data Set / Generation of Data

1. Types of Datasets

- **Soil Data:** Information on soil composition, moisture levels, pH, and nutrient content, which helps in assessing soil health and suitability for different crops.

- **Weather Data:** Historical and real-time weather data, including temperature, rainfall, humidity, and wind speed, which is crucial for planning planting and harvesting schedules.
- **Crop Data:** Details about different crop varieties, growth cycles, pest resistance, and yield data. This includes information on best practices for crop management.
- **Sensor Data:** Data from IoT sensors deployed in fields, including moisture sensors, temperature sensors, and pest traps, which provide real-time monitoring of crop conditions.
- **Remote Sensing Data:** Satellite or drone imagery that captures land use, vegetation health, and other spatial data to analyze crop performance and land conditions.
- **Market Data:** Pricing information for crops and agricultural products, which helps farmers make informed decisions about what to grow and when to sell.

2. Data Sources

- **Public Databases:** Government agricultural departments often provide datasets on soil types, crop yields, and climate conditions.
- **IoT Devices:** Smart sensors installed in farms collect real-time data on environmental conditions.
- **Remote Sensing Technology:** Drones and satellites capture high-resolution images and multispectral data.

3. Applications of Data in Smart Farming

- **Precision Agriculture:** Data analytics enable farmers to apply the right amount of inputs (water, fertilizers, pesticides) in specific areas of the field, reducing waste and improving efficiency.
- **Predictive Analytics:** Using historical and real-time data to predict crop yields, disease outbreaks, and market trends.
- **Decision Support Systems:** Integrating various datasets to provide actionable insights and recommendations for farmers.

- **Automated Farming:** Leveraging AI and robotics to automate tasks like planting, watering, and harvesting based on data-driven insights.

4. Challenges

- **Data Quality and Integration:** Ensuring the accuracy and consistency of data collected from multiple sources can be challenging.
- **Privacy and Security:** Protecting sensitive data related to farms and agricultural practices from unauthorized access.
- **Scalability:** As farms grow in size and complexity, managing and analyzing large datasets becomes increasingly difficult.

5. Future Trends

- **Machine Learning and AI:** Continued advancements in AI will enhance the ability to analyze large datasets for better decision-making.
- **Blockchain Technology:** Ensuring transparency and traceability in the agricultural supply chain.
- **Sustainable Practices:** Data-driven approaches to support sustainable agriculture and reduce environmental impact.

4.5 Module Description

4.5.1 Module1

DECISION TREE

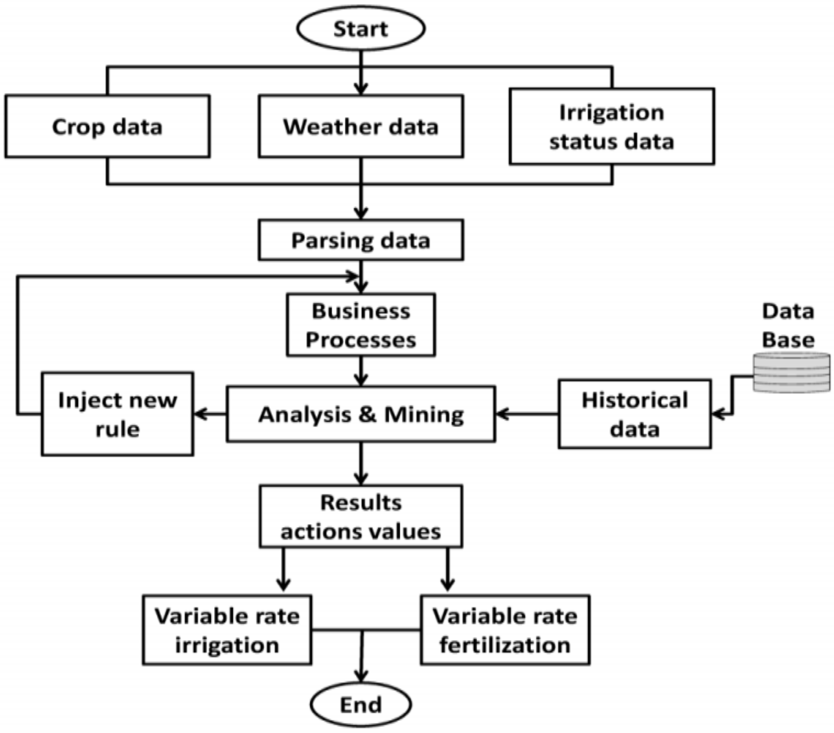


Figure 4.8: **Decision Tree**

Description:

A decision tree is a visual decision-making tool used in AI-based smart farming, representing choices and their potential outcomes. It consists of a root node (the initial decision), branches (possible outcomes), internal nodes (features like soil type or weather), and leaf nodes (final decisions).Decision trees operate by splitting data based on the most significant features that maximize information gain or minimize impurity. They are particularly useful in applications such as crop selection, irrigation management, pest control, and yield prediction.

4.5.2 Module2

COMPUTER VISION ALGORITHM

Computer vision algorithms are integral to AI-based smart farming, enabling various advanced functionalities that help in optimizing agricultural practices, improving crop health, and increasing yields. Here'show computer vision is used in smart farming:

1. Plant Disease Detection:

- Image Classification: Computer vision can analyze images of plants to detect diseases. Using deep learning models like Convolutional Neural Networks (CNNs), the system can classify and identify diseases from images of leaves, stems, or fruits.
- Real-time Monitoring: Cameras placed in the field can continuously monitor plants. When a disease is detected, the system can alert farmers, allowing for early intervention and reducing crop loss.

2. Weed Detection and Removal:

- Object Detection: Computer vision algorithms can distinguish between crops and weeds in a field. This information can be used to guide automated weeding machines or drones to target and remove weeds without harming the crops.
- Precision Spraying: Instead of spraying herbicides over an entire field, computer vision can help in applying them only where weeds are detected, reducing chemical usage and costs.

3. Crop Monitoring and Yield Prediction:

- Growth Stage Analysis: By analyzing images taken over time, computer vision can track the growth stages of crops, helping farmers make decisions on irrigation, fertilization, and harvest timing.
- Yield Estimation: Algorithms can estimate crop yield by counting the number of fruits or plants in an image. This helps in planning for harvest and market supply.

4. Soil and Water Management:

- Soil Condition Monitoring: High-resolution images of the soil can be analyzed to detect moisture levels, erosion, and nutrient deficiencies. This information can be used to optimize irrigation schedules and fertilization.
- Flood and Drought Detection: Drones equipped with cameras can fly over large areas to monitor water distribution. Computer vision can detect signs of drought or overwatering, enabling corrective actions.

5. Pest Detection and Management:

- Pest Identification: Computer vision can identify pests on plants by analyzing their images. This helps in early detection and targeted pest control, minimizing the damage to crops.
- Automated Traps and Repellents: Systems equipped with computer vision can activate traps or repellents when pests are detected in specific areas.

Chapter 5

IMPLEMENTATION AND TESTING

5.1 Input and Output

5.1.1 Input Design

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>AI-Based Smart Farming - Sign Up</title>
    <style>
        body {
            font-family: Arial, sans-serif;
            margin: 0;
            padding: 0;
            background-color: #f4f4f9;
            color: #333;
        }
        .container {
            max-width: 1200px;
            margin: auto;
            padding: 20px;
            display: flex;
            flex-direction: column;
            align-items: center;
        }
        h1 {
            color: #4CAF50;
        }
        .form-container {
            width: 100%;
            max-width: 500px;
            background: #fff;
            padding: 20px;
            border-radius: 8px;
            box-shadow: 0 0 10px rgba(0, 0, 0, 0.1);
            margin-bottom: 20px;
        }
        .form-container h2 {
            margin-top: 0;
            color: #333;
        }
        .form-group {
            margin-bottom: 15px;
        }
        .form-group label {
            display: block;
            margin-bottom: 5px;
```

```
        }
        .info-container p {
            line-height: 1.6;
        }
    </style>
</head>
<body>
    <div class="container">
        <div class="form-container">
            <h1>Sign Up for smart farming suggestions</h1>
            <form id="signupfor smart farming">
                <div class="form-group">
                    <label for="fullname">Full Name</label>
                    <input type="text" id="fullname" name="fullname" required>
                </div>
                <div class="form-group">
                    <label for="email">Email Address</label>
                    <input type="email" id="email" name="email" required>
                </div>
                <div class="form-group">
                    <label for="username">Username</label>
                    <input type="text" id="username" name="username" required>
                </div>
                <div class="form-group">
                    <label for="password">Password</label>
                    <input type="password" id="password" name="password" required>
                </div>
                <div class="form-group">
                    <button type="submit">Sign Up</button>
                </div>
            </form>
        </div>

        <div class="info-container">
            <h2>About Wheat</h2>
            <img src="crop.jpg.webp" alt="Wheat Image">
            <p><strong>Wheat</strong> is a major cereal grain and a staple food for a large portion of the world’s population. It is used to produce flour for bread, pasta, and other food products. Wheat grows in a variety of climates, from temperate to semi-arid regions, and is an important crop for food security globally.</p>
            <p>There are several types of wheat, including hard, soft, and durum wheat, each suited to different types of food products. Hard wheat is often used in bread-making due to its high gluten content, while soft wheat is used for pastries and cakes. Durum wheat is used primarily for pasta production.</p>
        </div>
    </div>
</body>
</html>
```

Figure 5.1: **Input Code for login page**

5.1.2 Output Design

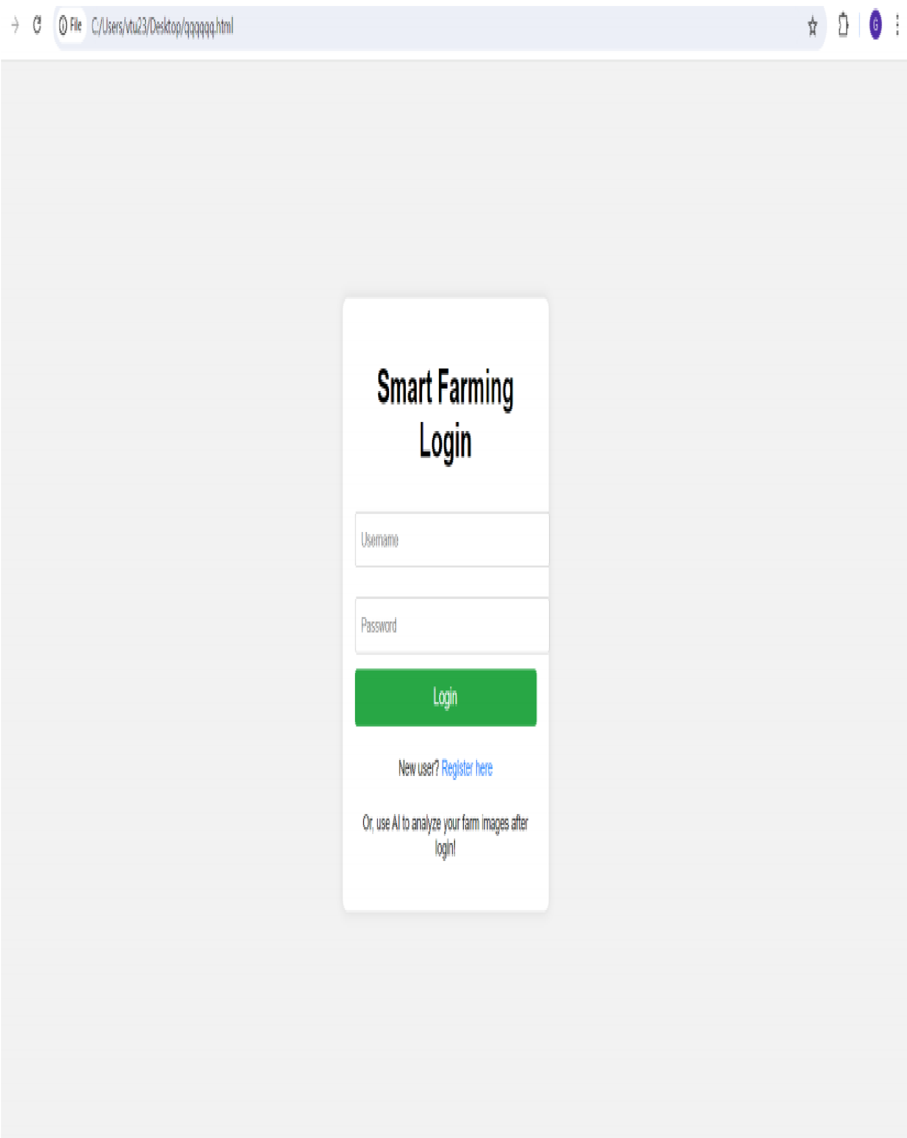


Figure 5.2: **Output Design for Login Page**

5.2 Testing

Testing in AI-based smart farming involves several key components. First, data collection must ensure sensors for soil moisture and temperature are accurate and reliable. Next, AI algorithms should be validated through model training and cross-validation to predict outcomes like crop yields and pest infestations effectively. Automation systems such as robotics and drones need performance evaluations to ensure efficiency in planting and monitoring. The user interface must be intuitive, displaying real-time insights and reliable alerts.

5.3 Types of Testing

5.3.1 Unit testing

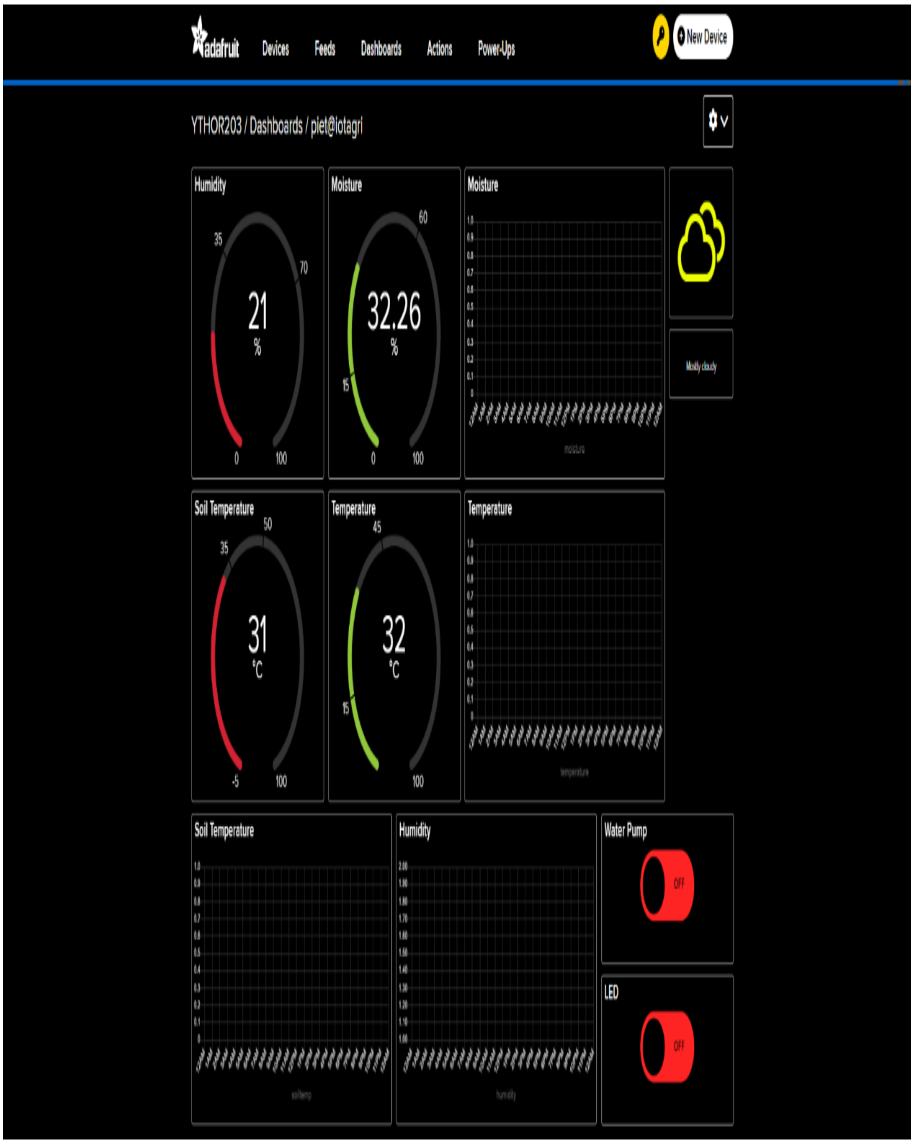


Figure 5.3: **Unit Testing**

5.3.2 Integration testing

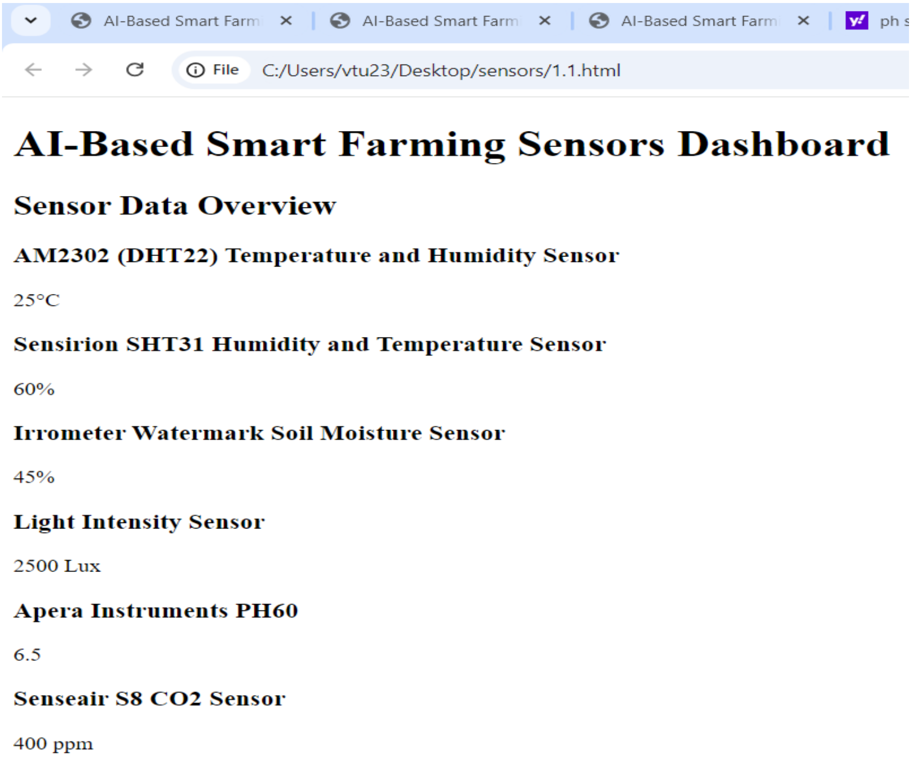


Figure 5.4: **Integration Testing**

5.3.3 System testing

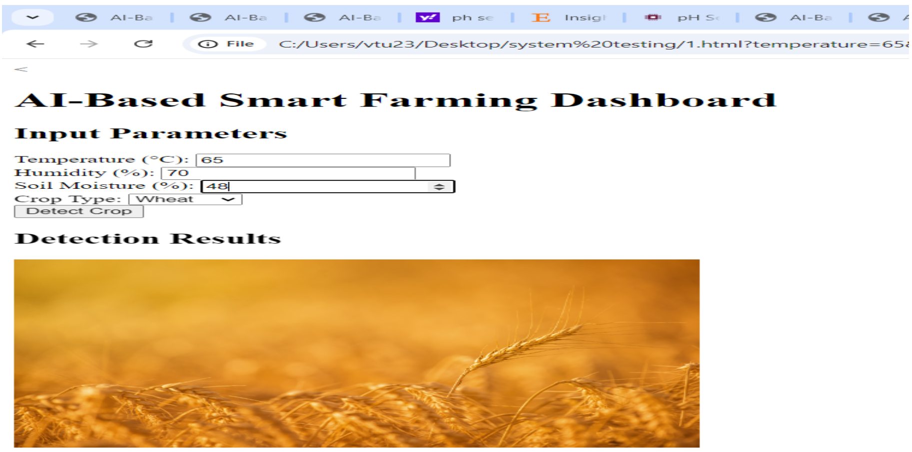


Figure 5.5: **System Testing**

5.3.4 Test Result

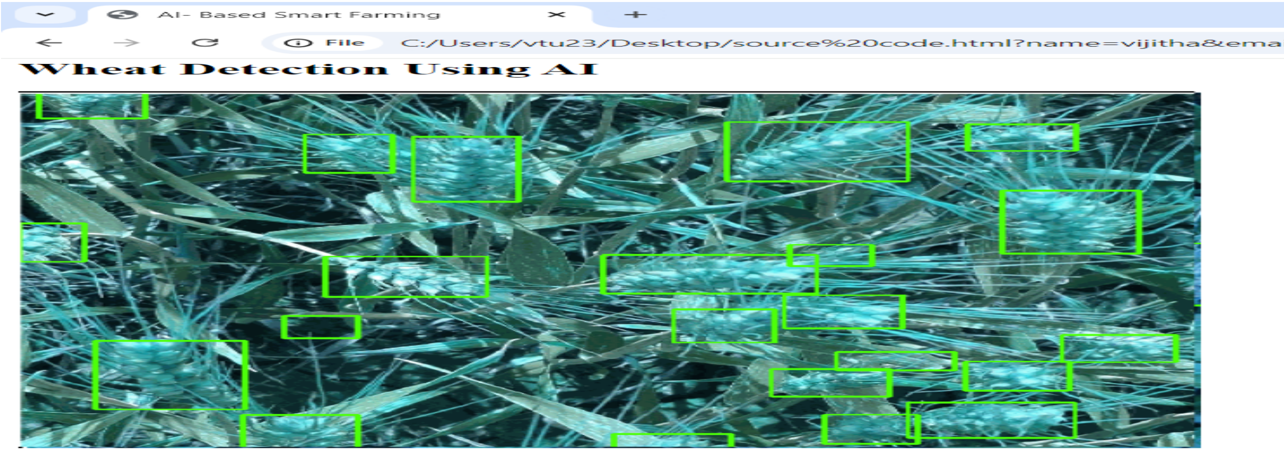


Figure 5.6: **Test Result**

Chapter 6

RESULTS AND DISCUSSIONS

6.1 Efficiency of the Proposed System

The proposed system is based on the Computer Vision Algorithm that creates many decision trees. Accuracy of proposed system is done by using random forest gives the ouput approximately 76 to 78 percent. Computer Vision implements many decision trees and also gives the most accurate output when compared to the decision tree. Computer Vision algorithm is used in the two phases. Firstly, the cv algorithm extracts subsamples from the original samples by using the bootstrap resampling method and creates the decision trees for each testing sample and then the algorithm classifies the decision trees and implements a vote with the help of the largest vote of the classification as a final result of the classification. The Computer Vision algorithm always includes some of the steps as follows: Selecting the training dataset:Using the bootstrap Computer Vision sampling method we can derive the training sets from the original dataset properties using the size of all training set the same as that of original training dataset. Building the Computer Vision algorithm: Creating a classification regression tree each of the bootstrap training set will generate the K decision trees to form a Computer Vision model, uses the trees that are not pruned. Looking at the growth of the tree, 31 this approach is not chosen the best feature as the internal nodes for the branches but rather the branching process is a Computer Vision selection of all the trees gives the best features.

6.2 Comparison of Existing and Proposed System

Existing system:

The Existing system, we implemented a decision tree algorithm that predicts whether to grant the result or not. When using a decision tree model, it gives the training dataset the accuracy keeps improving with splits. We can easily overfit the dataset and doesn't know when it crossed the line unless we are using the cross validation. The advantages of the decision tree are model is very easy to interpret we can know that the variables and the value of the variable is used to split the data. But the accuracy of decision tree in existing system gives less accurate output that is less when compared to proposed system.

Proposed system:

Computer vision algorithm generates more Datasets when compared to the decision tree and other algorithms. We can specify the number of Datasets we want in the system and also we also can specify maximum of features to be used in the each of the system. But, we cannot control the vision of the system in which the feature is a part of the algorithm. Accuracy keeps increasing as we increase the number of systems but it becomes static at one certain point. Unlike the decision tree it won't create more biased and decreases variance. Proposed system is implemented using the Computer vision algorithm so that the accuracy is more when compared to the existing system.

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>AI-Based Smart Farming - Sign Up</title>
    <style>
        body {
            font-family: Arial, sans-serif;
            margin: 0;
            padding: 0;
            background-color: #f4f4f9;
            color: #333;
        }
        .container {
            max-width: 1200px;
            margin: auto;
            padding: 20px;
            display: flex;
            flex-direction: column;
            align-items: center;
        }
        h1 {
            color: #4CAF50;
        }
        .form-container {
            width: 100%;
            max-width: 500px;
            background: #fff;
            padding: 20px;
```

```
            border-radius: 8px;
            box-shadow: 0 0 10px rgba(0, 0, 0, 0.1);
            margin-bottom: 20px;
        }
        .form-container h2 {
            margin-top: 0;
            color: #333;
        }
        .form-group {
            margin-bottom: 15px;
        }
        .form-group label {
            display: block;
            margin-bottom: 5px;
        }
        .form-group input {
            width: 100%;
            padding: 10px;
            border: 1px solid #ccc;
            border-radius: 4px;
        }
        .form-group button {
            background-color: #4CAF50;
            color: white;
            border: none;
            padding: 15px;
            border-radius: 4px;
            cursor: pointer;
            width: 100%;
            font-size: 16px;
        }
        .form-group button:hover {
            background-color: #45a049;
        }
        .info-container {
            width: 40%;
            max-width: 800px;
            background: #fff;
            padding: 20px;
            border-radius: 8px;
            box-shadow: 0 0 10px rgba(0, 0, 0, 0.1);
        }
        .info-container h2 {
            color: #4CAF50;
        }
        .info-container img {
            width: 100%;
            height: auto;
            border-radius: 8px;
        }
```

```
        .info-container p {
            line-height: 1.6;
        }
    </style>
</head>
<body>
    <div class="container">
        <div class="form-container">
            <h1>Sign Up for smart farming suggestions</h1>
            <form id="signupfor smart farming">
                <div class="form-group">
                    <label for="fullname">Full Name</label>
                    <input type="text" id="fullname" name="fullname" required>
                </div>
                <div class="form-group">
                    <label for="email">Email Address</label>
                    <input type="email" id="email" name="email" required>
                </div>
                <div class="form-group">
                    <label for="username">Username</label>
                    <input type="text" id="username" name="username" required>
                </div>
                <div class="form-group">
                    <label for="password">Password</label>
                    <input type="password" id="password" name="password" required>
                </div>
                <div class="form-group">
                    <button type="submit">Sign Up</button>
                </div>
            </form>
        </div>
        <div class="info-container">
            <h2>About Wheat</h2>
            <img src="crop.jpg.webp" alt="Wheat Image">
            <p><strong>Wheat</strong> is a major cereal grain and a staple food for a large portion
                of the worlds population. It is used to produce flour for bread, pasta, and other
                food products. Wheat grows in a variety of climates, from temperate to semi-arid
                regions, and is an important crop for food security globally.</p>
            <p>There are several types of wheat, including hard, soft, and durum wheat, each suited
                to different types of food products. Hard wheat is often used in bread-making due to
                its high gluten content, while soft wheat is used for pastries and cakes. Durum
                wheat is used primarily for pasta production.</p>
        </div>
    </div>
</body>
</html>
```

Output

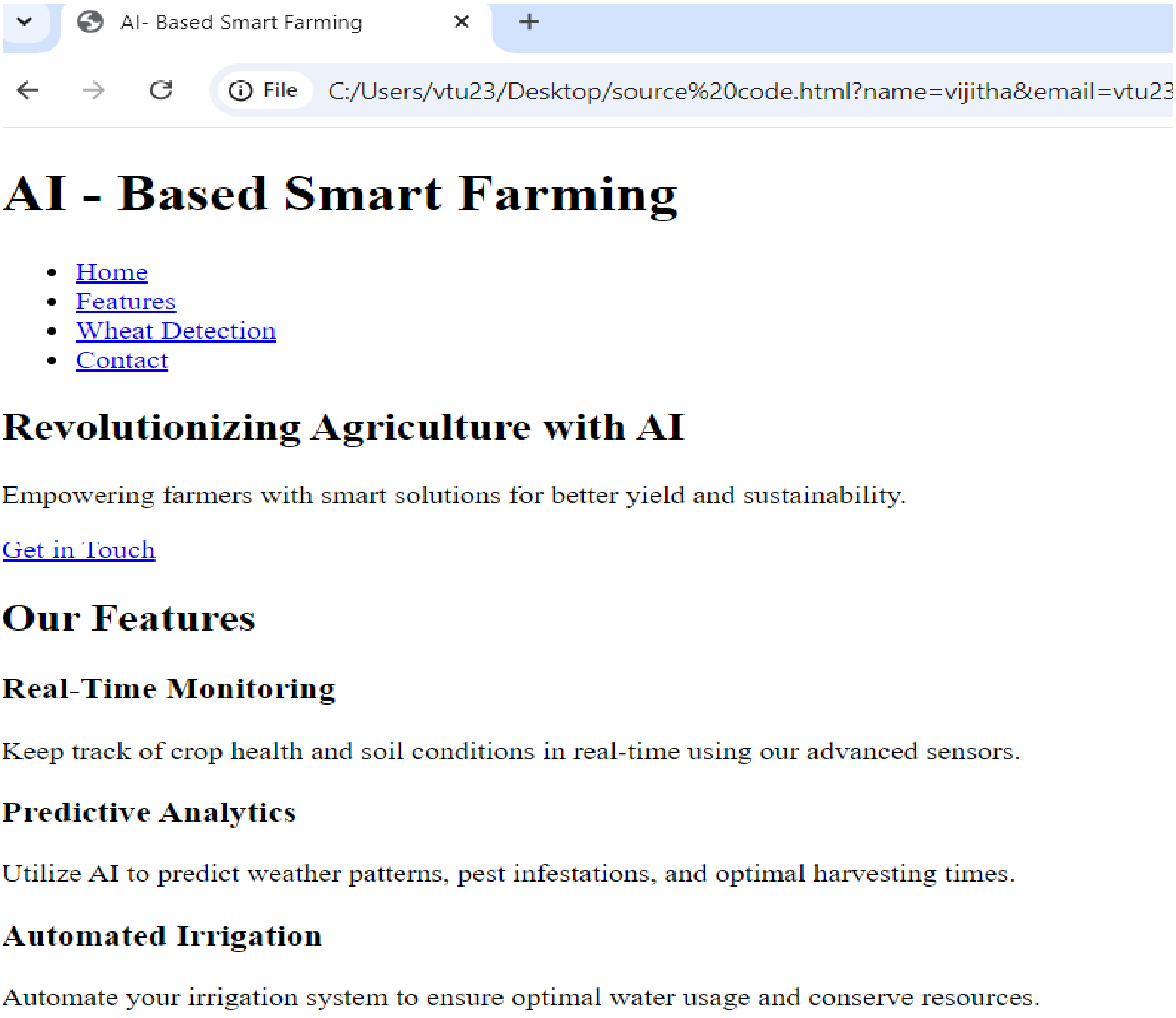


Figure 6.1: **Home Page**

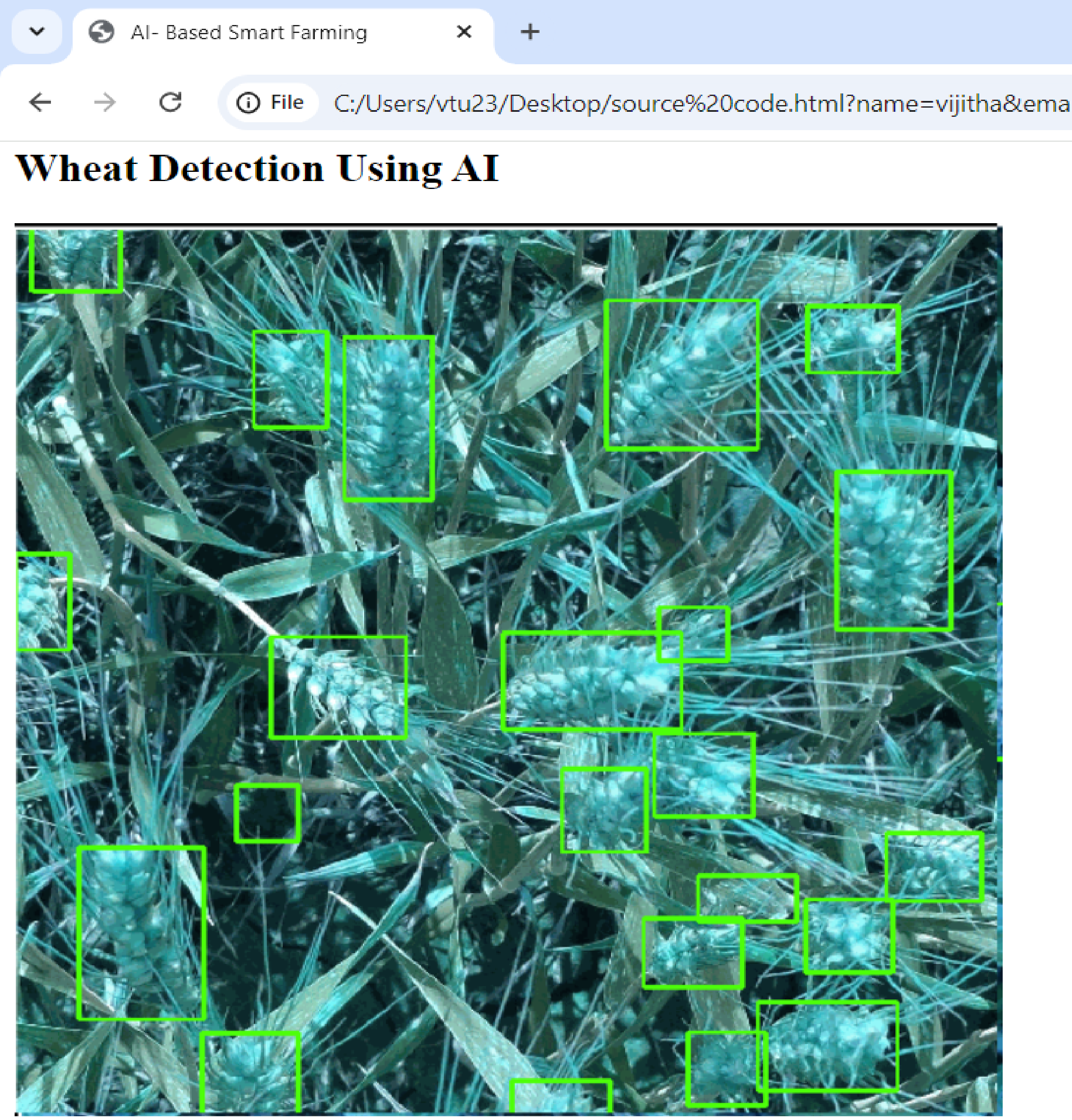


Figure 6.2: **Crop Detection**

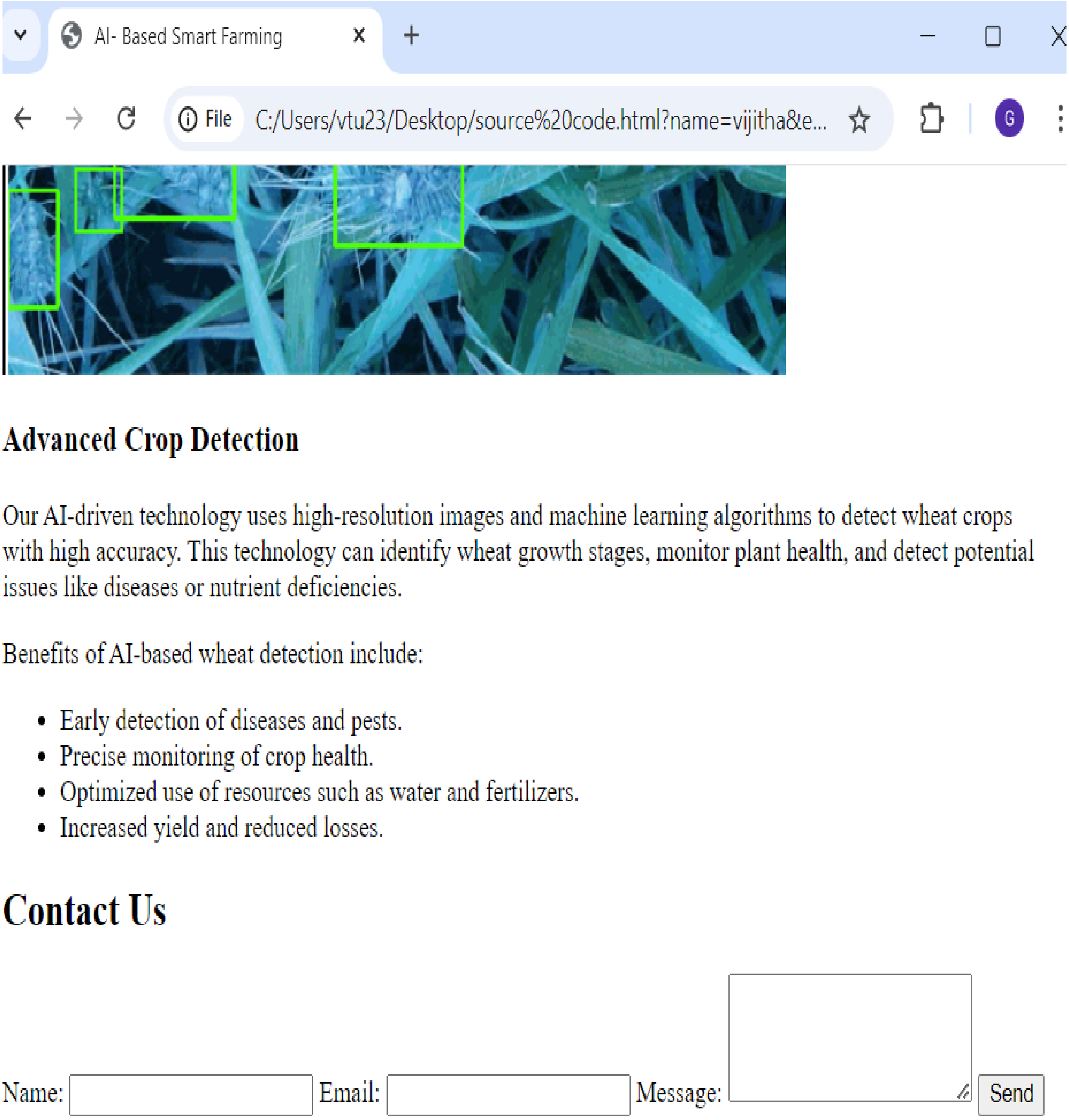


Figure 6.3: **Crop Prediction**

Chapter 7

CONCLUSION AND FUTURE ENHANCEMENTS

7.1 Conclusion

AI-based smart farming represents a transformative approach to agriculture, leveraging advanced technologies to enhance productivity, sustainability, and efficiency. By integrating data analytics, machine learning algorithms, and IoT devices, farmers can make informed decisions that optimize resource use, improve crop yields, and reduce environmental impact. Techniques such as precision agriculture, predictive analytics, and automated systems enable real-time monitoring and management of farming operations, leading to more efficient practices.

Moreover, tools like decision trees and Computer vision algorithm facilitate effective data analysis, whether for classifying crops or detecting diseases. The adoption of AI in agriculture not only supports increased food production to meet global demands but also promotes sustainable practices that are vital for the health of our planet. As technology continues to evolve, AI-based smart farming will play a critical role in shaping the future of agriculture, driving innovation, and ensuring food security for generations to come.

7.2 Future Enhancements

Future enhancements for AI-based smart farming will focus on several key areas to improve productivity and sustainability. Integrating advanced sensors, such as multi-spectral and soil sensors, will enable real-time monitoring of crop health and soil conditions. Precision agriculture technologies, including drones and automated machinery, will enhance efficiency in farming operations.

Machine learning and deep learning models will provide more accurate yield predictions and pest forecasts. Blockchain technology will enhance supply chain transparency and automate transactions through smart contracts. Climate adaptation strategies will promote resilient crops and optimize water management. Collaborative platforms will facilitate knowledge sharing among farmers, while intuitive dashboards and mobile applications will simplify data interpretation.

Chapter 8

PLAGIARISM REPORT

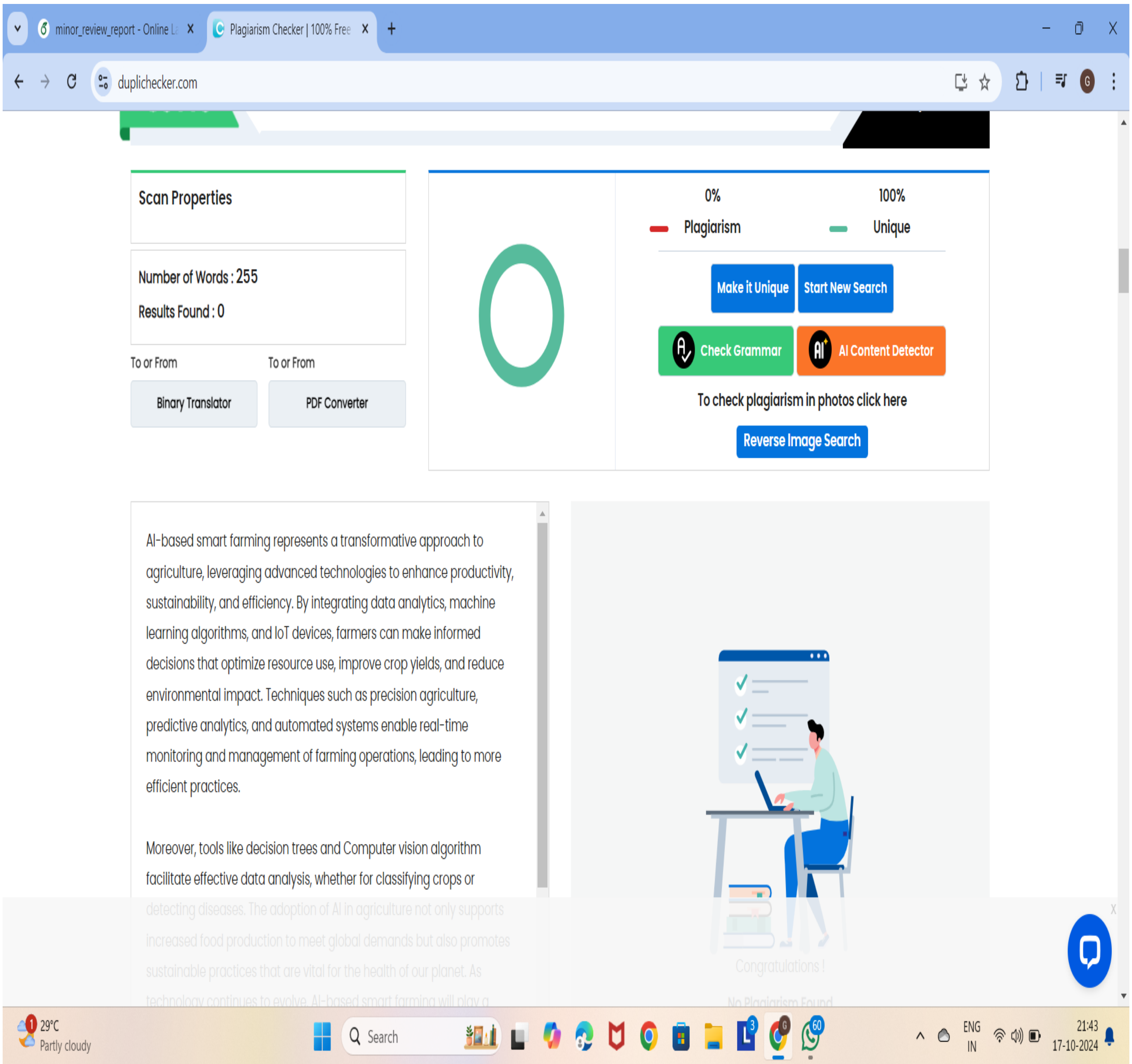
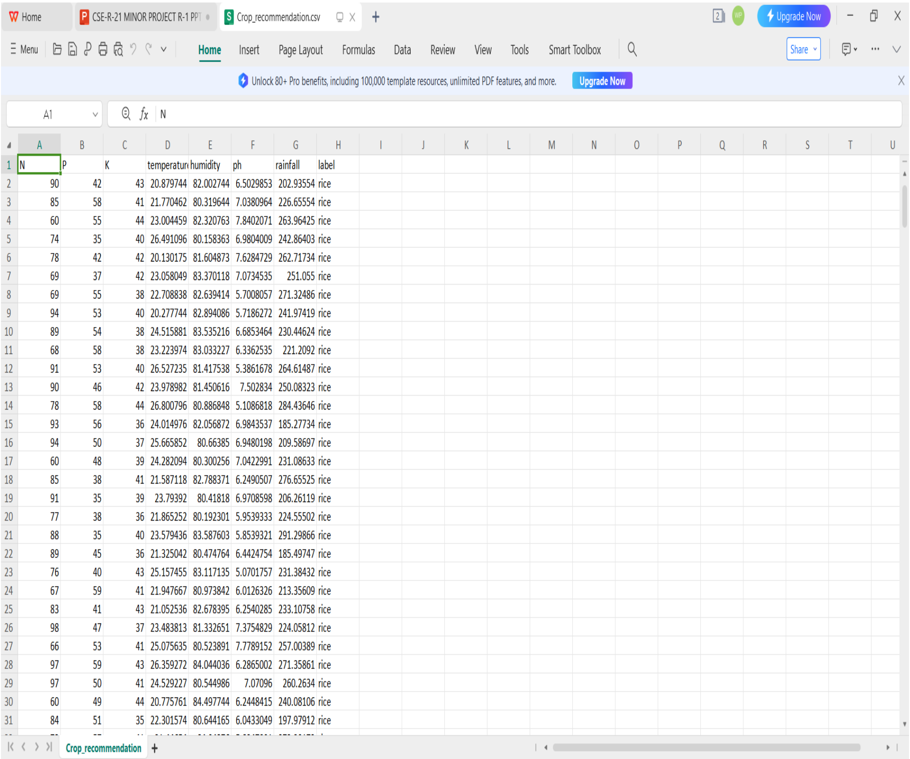


Figure 8.1: **Plagiarism report**

Appendices

Appendix A

Complete Data / Sample Data / Sample Source Code / etc



N	P	K	temperatur	humidity	ph	rainfall	label
90	42	43	20.879744	82.002744	6.5029853	202.93554	rice
85	58	41	21.770462	80.319644	7.0380964	226.65554	rice
60	55	44	23.004459	82.320763	7.8402071	263.96425	rice
74	35	40	26.491096	80.158363	6.9804009	242.86403	rice
78	42	42	20.130175	81.604873	7.6284729	262.71734	rice
69	37	42	23.058049	83.370118	7.0734535	251.055	rice
69	55	38	22.708838	82.639414	5.7008057	271.32486	rice
94	53	40	20.277744	82.894086	5.7186272	241.97419	rice
89	54	38	24.515881	83.535216	6.6853464	230.44624	rice
68	58	38	23.223974	83.033227	6.3362535	221.2092	rice
91	53	40	26.527235	81.417538	5.3861678	264.61487	rice
90	46	42	23.978982	81.450616	7.502834	250.08323	rice
78	58	44	26.800796	80.886848	5.1086818	284.43646	rice
93	56	36	24.014976	82.056872	6.9843537	185.27734	rice
94	50	37	25.665852	80.66385	6.9480198	209.58697	rice
60	48	39	24.282094	80.300256	7.0422991	231.08633	rice
85	38	41	21.587118	82.788371	6.2490507	276.65525	rice
91	35	39	23.79392	80.41818	6.9708598	206.26119	rice
77	38	36	21.865252	80.192301	5.9539333	224.55502	rice
88	35	40	23.579436	83.587603	5.8539321	291.29866	rice
89	45	36	21.325042	80.474764	6.4424754	185.49747	rice
76	40	43	25.157455	83.117135	5.0701757	231.38432	rice
67	59	41	21.947667	80.973842	6.0126326	213.35609	rice
83	41	43	21.052536	82.678395	6.2540285	233.10758	rice
98	47	37	23.483813	81.332651	7.3754829	224.05812	rice
66	53	41	25.075635	80.523891	7.7789152	257.00389	rice
97	59	43	26.359272	84.044036	6.2865002	271.35861	rice
97	50	41	24.529227	80.544986	7.07096	260.2634	rice
60	49	44	20.775761	84.497744	6.2448415	240.08106	rice
84	51	35	22.301574	80.644165	6.0433049	197.97912	rice

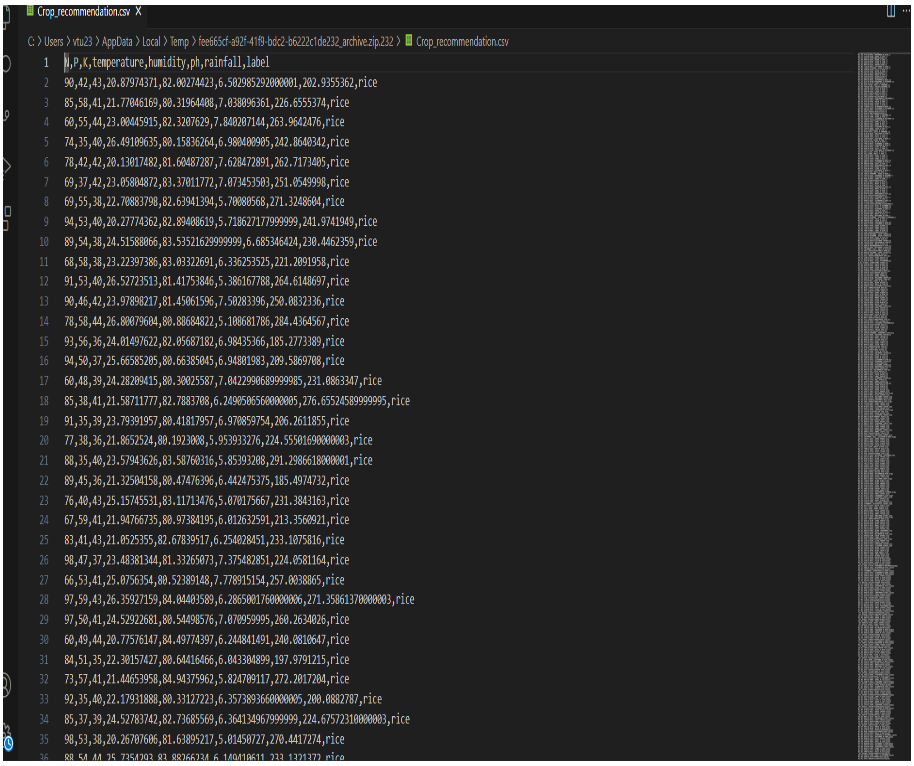


Figure A.1: **Sample Data**

References

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