Industrial Internship Report on

” Prediction of Agriculture Crop prediction”

Prepared by

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Executive Summary
This report provides details of the Industrial Internship provided by upskill Campus and The IoT Academy in collaboration with Industrial Partner UniConverge Technologies Pvt Ltd (UCT). This internship was focused on a project/problem statement provided by UCT. We had to finish the project including the report in 6 weeks' time. My project was Prediction of Agriculture Crop prediction. This internship gave me a very good opportunity to get exposure to Industrial problems and design/implement solution for that. It was an overall great experience to have this internship.

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1 Preface

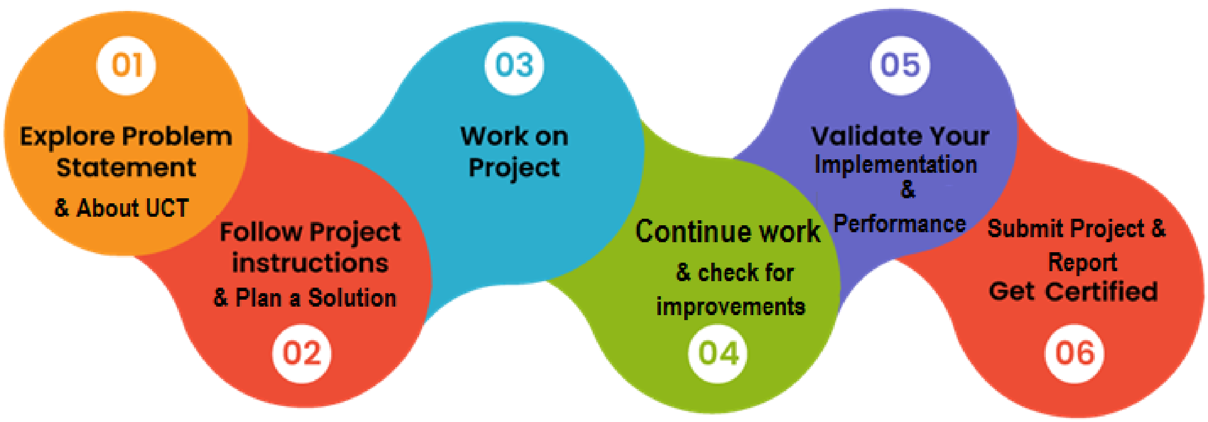
Summary of the whole 6 weeks' work.

About need of relevant Internship in career development.

Brief about Your project/problem statement.

Opportunity given by USC/UCT.

How Program was planned



Your Learnings and overall experience.

Thank to all the team members of edunet unicoverage teams , who have helped you directly or indirectly.

Your message to your juniors and peers.

2 Introduction

2.1 About UniConverge Technologies Pvt Ltd

A company established in 2013 and working in Digital Transformation domain and providing Industrial solutions with prime focus on sustainability and RoI.

For developing its products and solutions it is leveraging various **Cutting Edge Technologies e.g. Internet of Things (IoT), Cyber Security, Cloud computing (AWS, Azure), Machine Learning, Communication Technologies (4G/5G/LoRaWAN), Java Full Stack, Python, Front end** etc.

i. UCT IoT Platform ( )

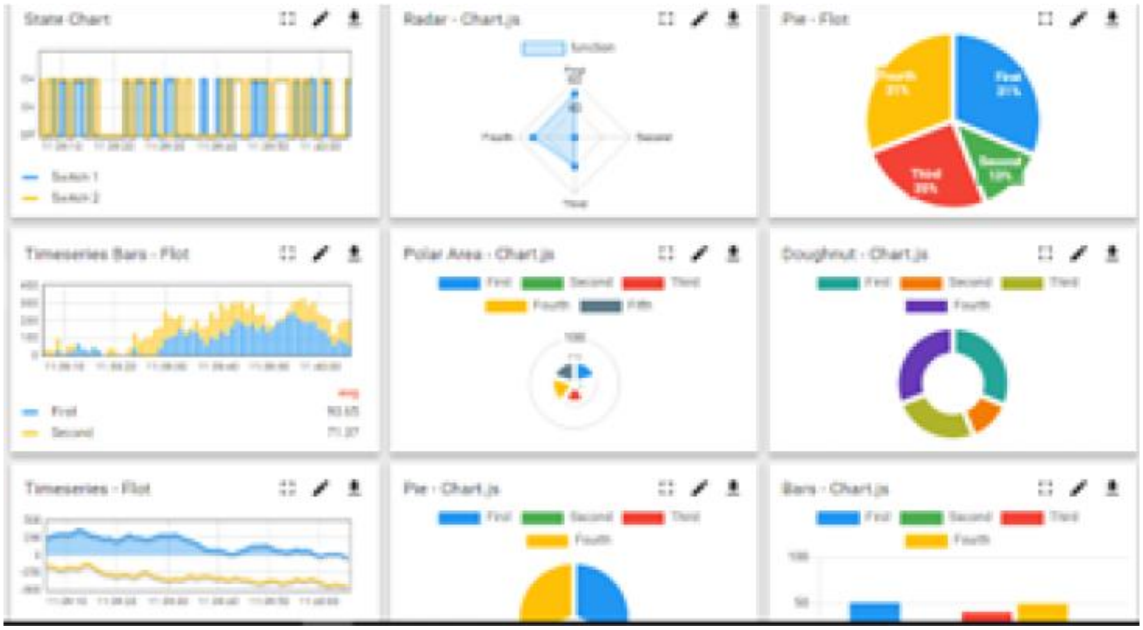
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

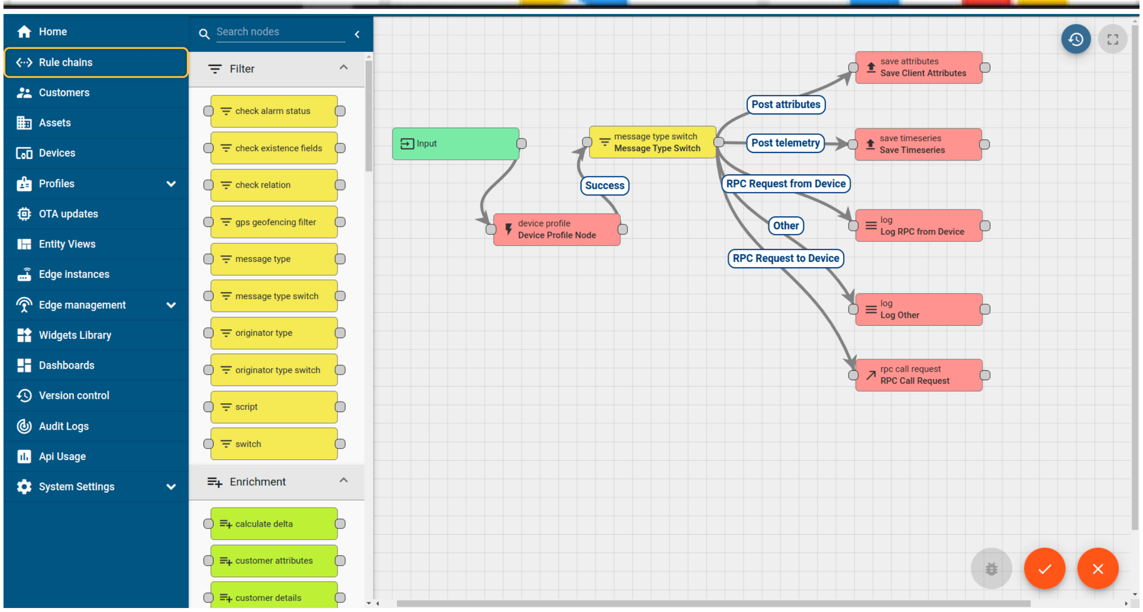
- It enables device connectivity via industry standard IoT protocols - MQTT, CoAP, HTTP, Modbus TCP, OPC UA upSkill CAMPUS UNIVERSAL uct

- It supports both cloud and on-premises deployments.

It has features to

• Build Your own dashboard
• Analytics and Reporting
• Alert and Notification
• Integration with third party application(Power BI, SAP, ERP)
• Rule Engine





ii. Smart Factory Platform (FACTORY WATCH)

Factory watch is a platform for smart factory needs.

It provides Users/ Factory

- with a scalable solution for their Production and asset monitoring
- OEE and predictive maintenance solution scaling up to digital twin for your assets.
- to unleased the true potential of the data that their machines are generating and helps to identify the KPIs and also improve them.
- A modular architecture that allows users to choose the service that they what to start and then can scale to more complex solutions as per their demands.

Its unique SaaS model helps users to save time, cost and money.

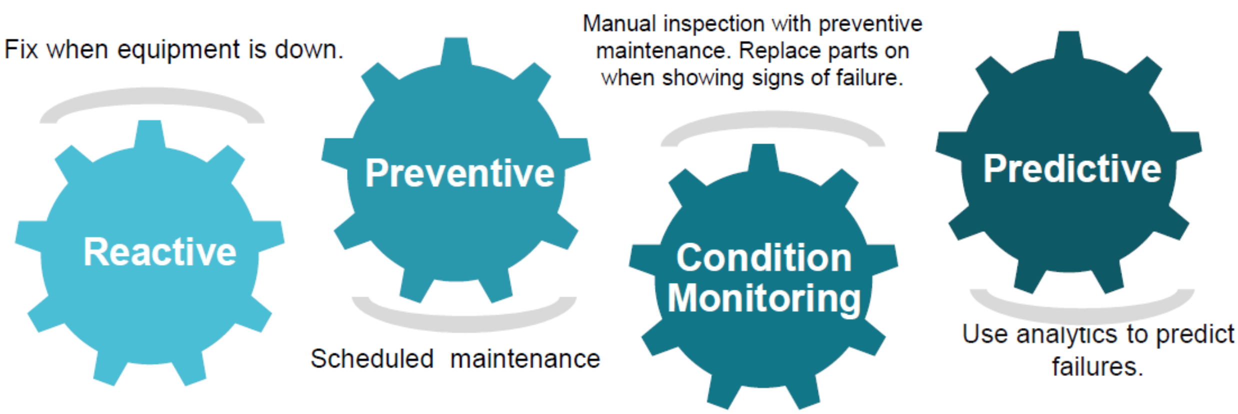
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i

iii. LoRaWAN based Solution

UCT is one of the early adopters of LoRAWAN teschnology and providing solution in Agritech, Smart cities, Industrial Monitoring, Smart Street Light, Smart Water/ Gas/ Electricity metering solutions etc.

iv. Predictive Maintenance

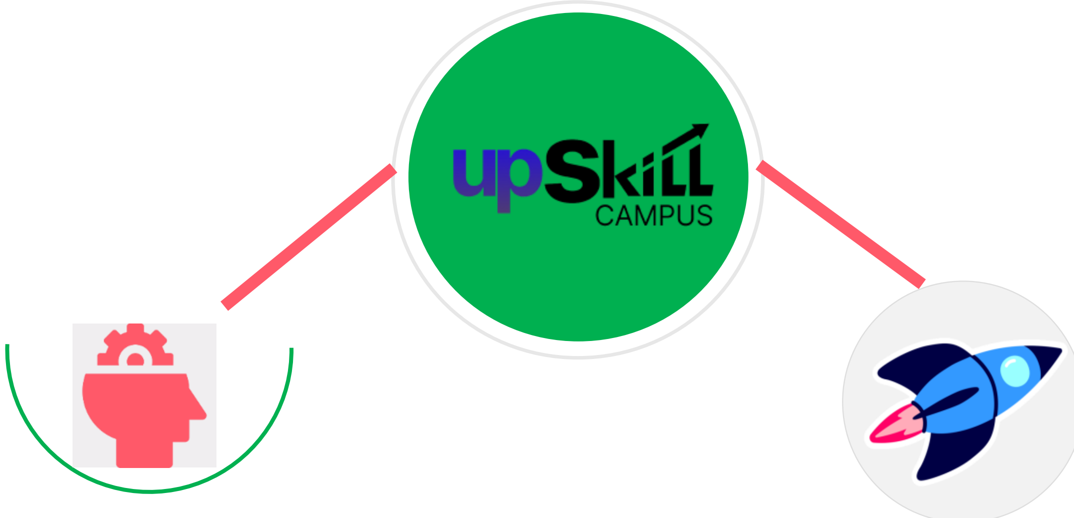
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



2.2 About upskill Campus (USC)

upskill Campus along with The IoT Academy and in association with Uniconverge technologies has facilitated the smooth execution of the complete internship process.

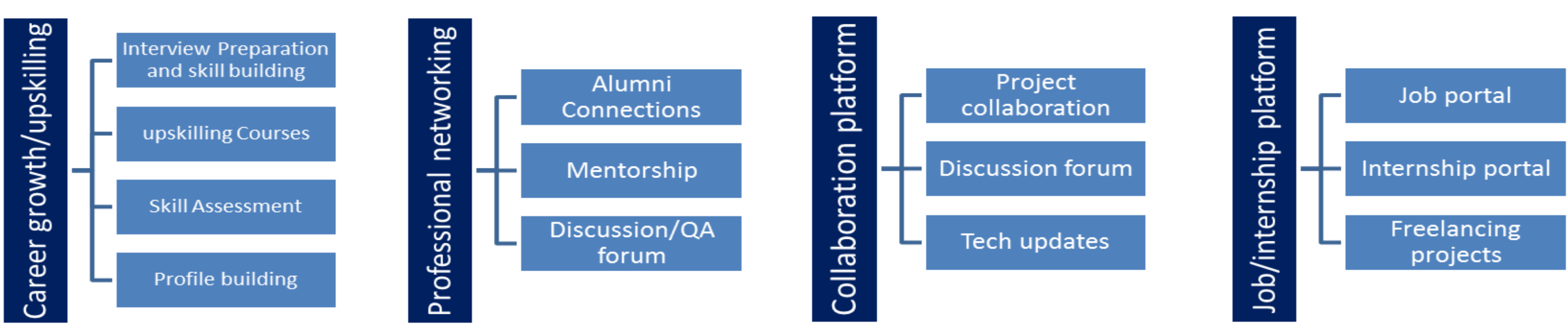
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



Seeing need of upskilling in self paced manner along-with additional support services e.g. Internship, projects, interaction with Industry experts, Career growth Services

upSkill Campus aiming to upskill 1 million learners in next 5 year

https://www.upskillcampus.com/



2.3 The IoT Academy

The IoT academy is EdTech Division of UCT that is running long executive certification programs in collaboration with EICT Academy, IITK, IITR and IITG in multiple domains.

2.4 Objectives of this Internship program

The objective for this internship program was to

☛ get practical experience of working in the industry.

☛ to solve real world problems.

☛ to have improved job prospects.

☛ to have Improved understanding of our field and its applications.

☛ to have Personal growth like better communication and problem solving.

2.5 Reference

[1] https://www.kaggle.com/

[2] https://www.youtube.com/

[3] https://croplife.org/

2.6 Glossary

Terms	Acronym
Hyperspectral Imaging	A technology used to capture and process information across various wavelengths of light to assess crop health and predict yields.
Nitrogen Use Efficiency (NUE)	The efficiency with which plants use available nitrogen, impacting growth and yield.
Vegetation Index	A quantitative measure of vegetation greenness and health, derived from remote sensing data.
Weather Forecasting	The prediction of atmospheric conditions, crucial for planning agricultural activities and anticipating crop performance.
Agroclimatic Data	Information on the climate conditions of a specific agricultural region, crucial for crop prediction.

3 Problem Statement

Agriculture crop prediction and protection involve leveraging advanced technologies and data analytics to enhance the efficiency and sustainability of farming practices. Crop prediction focuses on forecasting yields, growth stages, and potential challenges by analyzing various factors such as weather patterns, soil conditions, and historical crop data. This helps farmers make informed decisions about planting, irrigation, fertilization, and harvesting to maximize productivity and minimize waste. Protection, on the other hand, encompasses strategies and tools to safeguard crops from pests, diseases, and adverse environmental conditions. This includes the use of pesticides, biological control methods, and integrated pest management techniques. By predicting potential threats and implementing timely protection measures, farmers can significantly reduce crop losses and ensure a stable food supply. Together, these practices aim to optimize resource use, increase crop resilience, and promote sustainable agriculture, thereby addressing the global challenges of food security and environmental conservation.

Agriculture is a crucial sector that significantly impacts the global economy and food security. Predicting crop yields and protecting crops from various threats are essential for ensuring sustainable agricultural practices and food supply. Advances in technology, such as machine learning, remote sensing, and data analytics, can provide valuable insights to farmers and agricultural stakeholders, enabling better decision-making and resource management.

1. Crop Yield Prediction:

- Challenge: Accurately predicting crop yields based on various factors such as weather conditions, soil health, crop management practices, and pest infestations.

- Impact: Inaccurate predictions can lead to poor planning, either resulting in excess supply and wastage or shortage and unmet demand, directly affecting farmers' income and market stability.

2. Pest and Disease Management:

- Challenge: Identifying and managing pest infestations and plant diseases early and effectively to minimize damage to crops.

- Impact: Failure to detect and control pests and diseases promptly can lead to significant crop losses, increased use of chemical pesticides, and adverse environmental effects, ultimately threatening food security and farmer livelihoods.

3. Climate Change Adaptation:

- Challenge: Adapting agricultural practices to the changing climate conditions, which include unpredictable weather patterns, extreme events, and shifts in growing seasons.

- Impact: Climate change poses a risk to traditional farming practices and crop viability, necessitating the development of resilient crop varieties and adaptive management strategies to ensure sustainable agricultural production and food security.

4 Existing and Proposed solution

Agricultural crop prediction and protection are crucial for ensuring food security and optimizing resource use. Existing solutions for crop prediction often leverage traditional methods, such as historical yield data analysis, weather pattern observation, and expert assessments. These methods, while useful, can be limited by their reliance on past data and human judgment. In recent years, advancements in technology have enhanced prediction accuracy. Techniques such as remote sensing, which uses satellite imagery to monitor crop health and growth stages, and machine learning algorithms that analyze large datasets to predict crop yields, have become more prevalent. These approaches allow for more dynamic and real-time analysis of crop conditions.

For crop protection, conventional methods include the use of chemical pesticides, crop rotation, and manual monitoring of pests and diseases. However, these methods can be labor-intensive, environmentally harmful, and less effective against new or resistant pest strains. To address these challenges, integrated pest management (IPM) strategies have been developed, combining biological controls, cultural practices, and judicious use of chemical treatments to minimize damage while reducing environmental impact.

Proposed solutions are increasingly focused on precision agriculture and the integration of digital technologies. Internet of Things (IoT) devices, such as soil moisture sensors and weather stations, provide real-time data that can inform irrigation schedules and predict pest outbreaks. Artificial intelligence (AI) and big data analytics are being employed to process this data, offering actionable insights for farmers. Additionally, drone technology is being used for targeted pesticide application, reducing chemical use and preventing over-application.

Moreover, genetic advancements like CRISPR are being explored to develop crops that are more resistant to pests and diseases. Blockchain technology is also proposed to enhance transparency and traceability in the supply chain, ensuring better monitoring of crop health and protection practices from farm to table.

In summary, while traditional methods have provided a foundation for crop prediction and protection, the integration of modern technologies offers a promising future. These innovative approaches aim to enhance accuracy, efficiency, and sustainability, ultimately leading to more resilient agricultural systems.

4.1 Code submission (Github link):

https://github.com/Rahuljagwan/upskillcampus/tree/master/Prediction%20Of%20Crop%20Production

4.2 Report submission (Github link) :

https://github.com/Rahuljagwan/upskillcampus/blob/master/PredictionOfCropProduction_RahulJagwan_USC_UCT.pdf

5 Proposed Design/ Model

The proposed design for agriculture crop prediction and protection integrates advanced technologies to enhance farming efficiency and sustainability. Central to this model is the deployment of a robust data collection framework, utilizing IoT sensors and satellite imagery to gather real-time information on soil health, weather conditions, and crop growth stages. Machine learning algorithms analyze this data to forecast crop yields and identify potential threats from pests, diseases, and adverse weather. Predictive analytics enable farmers to make informed decisions regarding irrigation, fertilization, and pest control, optimizing resource use and minimizing environmental impact. Additionally, a decision support system provides tailored recommendations based on historical data, current trends, and predictive insights. Farmers receive alerts and actionable advice through a user-friendly mobile application, ensuring timely interventions. The model also emphasizes community involvement and knowledge sharing through a cloud-based platform where farmers can exchange insights and best practices. By integrating precision agriculture, predictive analytics, and real-time monitoring, this design aims to boost productivity, reduce losses, and promote sustainable farming practices.

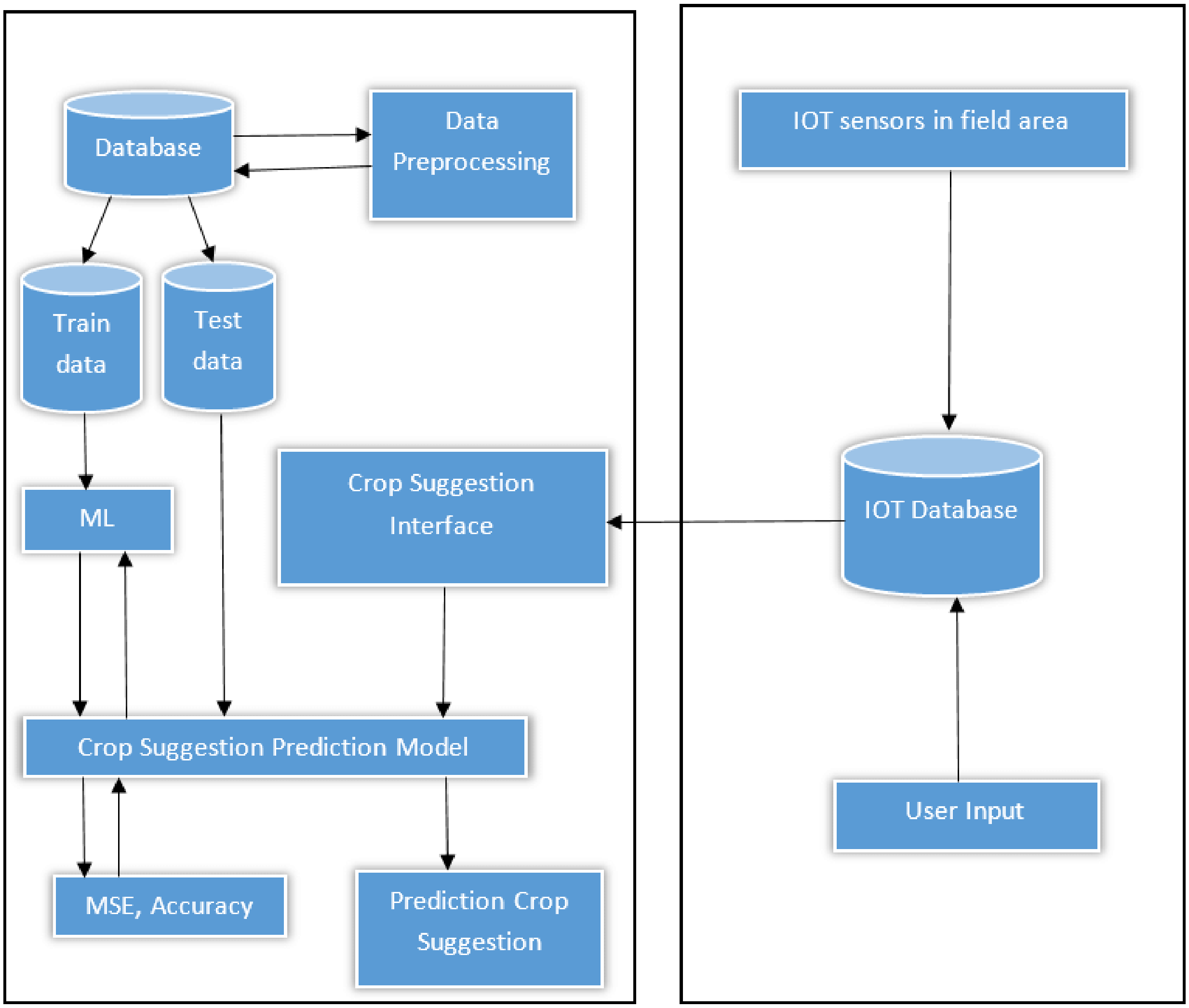
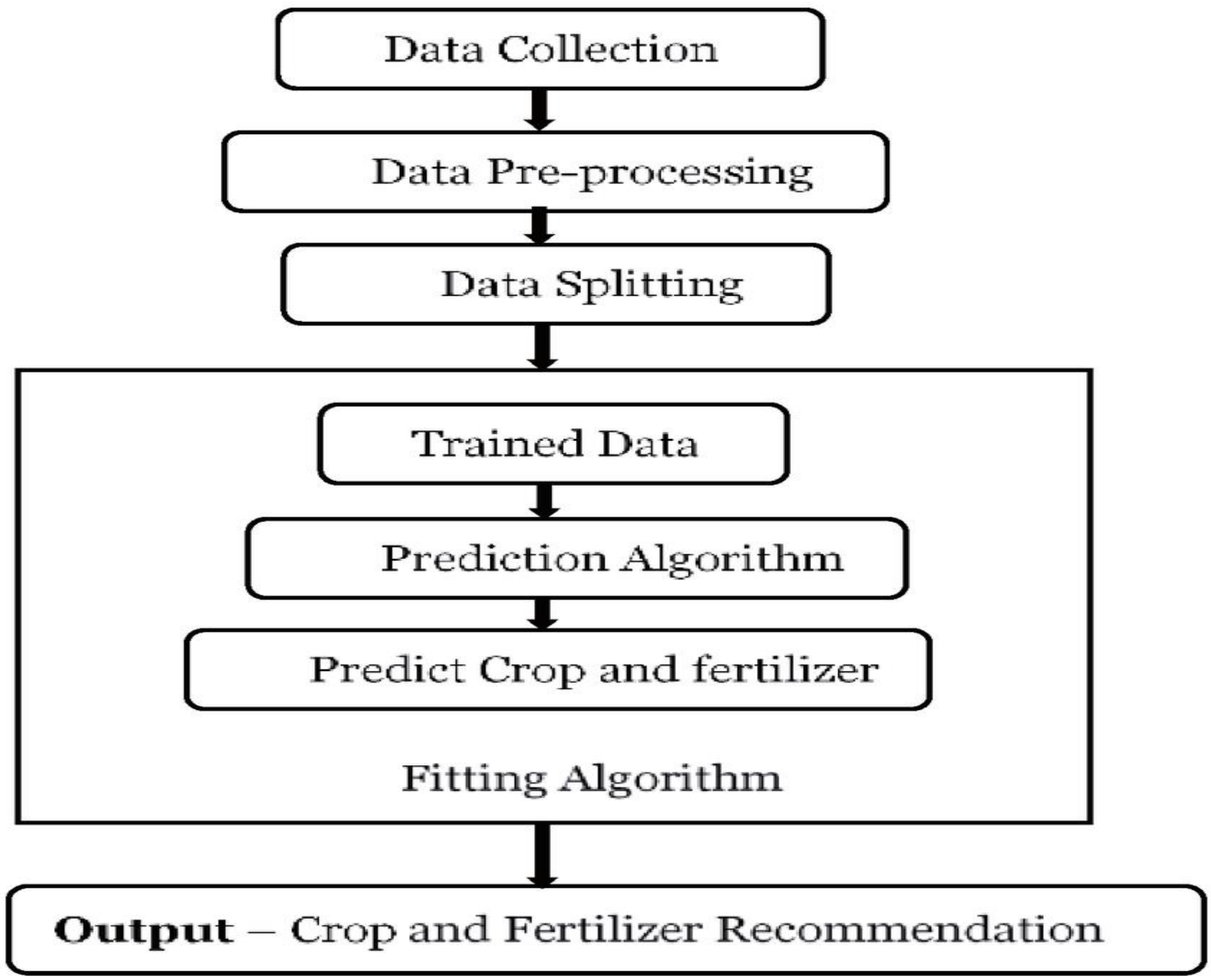


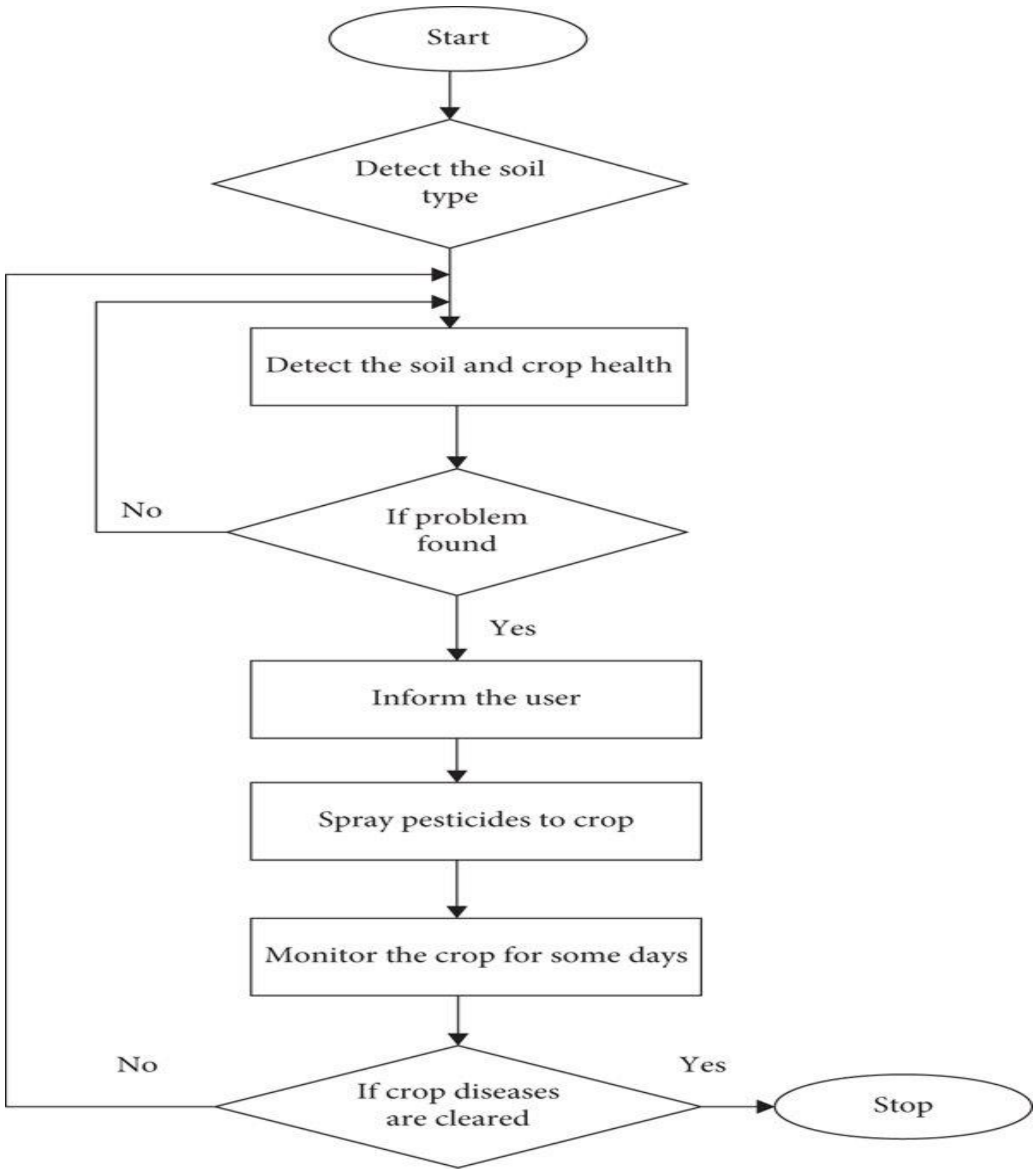
Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

5.1 Low Level Diagram (if applicable)

5.2 Interfaces (if applicable)



5.3 Flowchart


Start
Detect the soil type
Detect the soil and crop health
No
If problem found
Yes
Inform the user
Spray pesticides to crop
Monitor the crop for some days
No
Yes
If crop diseases are cleared
Stop

6 Performance Test

This is very important part and defines why this work is meant of Real industries, instead of being just academic project.

Here we need to first find the constraints.

How those constraints were taken care in your design?

What were test results around those constraints?

Constraints can be e.g. memory, MIPS (speed, operations per second), accuracy, durability, power consumption etc.

In case you could not test them, but still you should mention how identified constraints can impact your design, and what are recommendations to handle them.

6.1 Test Plan/ Test Cases

In an agriculture crop prediction project, various test cases are crucial for evaluating the accuracy and effectiveness of the predictive models. Firstly, historical data spanning multiple years should be used to test the model's ability to accurately predict crop yields for past seasons. This involves feeding the model with known data and comparing its predictions against the actual yields.

Secondly, cross-validation techniques can be employed to assess the model's performance across different subsets of the data. This ensures that the predictive capability remains robust across various scenarios and prevents overfitting.

Thirdly, sensitivity analysis can be conducted to test the model's resilience to changes in input variables such as weather patterns, soil conditions, and agricultural practices. This helps in understanding the model's reliability under different real-world conditions.

Furthermore, stress testing the model with extreme scenarios, such as severe weather events or unexpected changes in agricultural practices, can reveal its limitations and areas for improvement.

Lastly, field testing the predictions against real-time data from ongoing agricultural seasons provides valuable feedback on the model's practical utility and its ability to adapt to dynamic conditions in the field. Overall, a comprehensive set of test cases ensures the robustness and reliability of the agriculture crop prediction project.

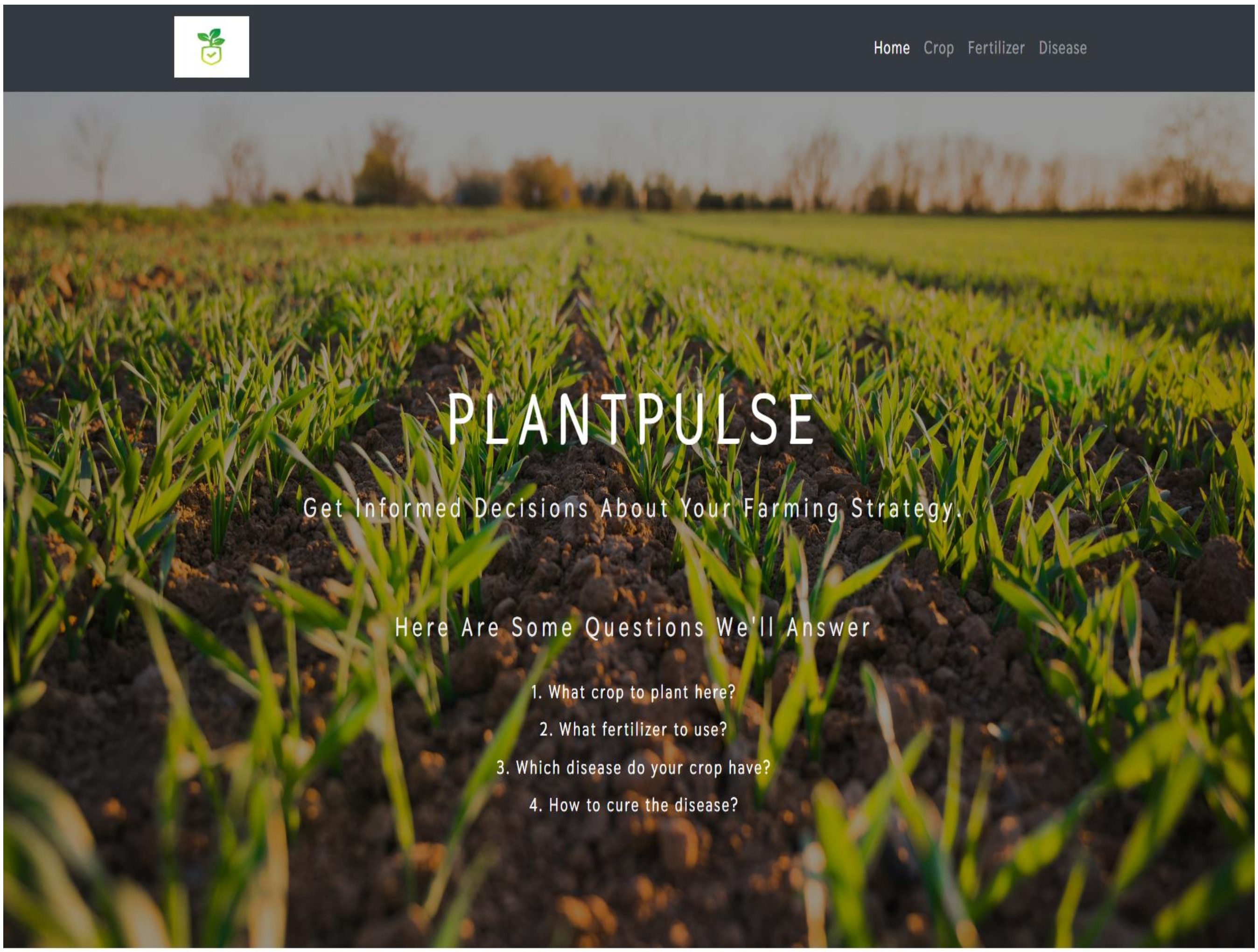
6.2 Test Procedure

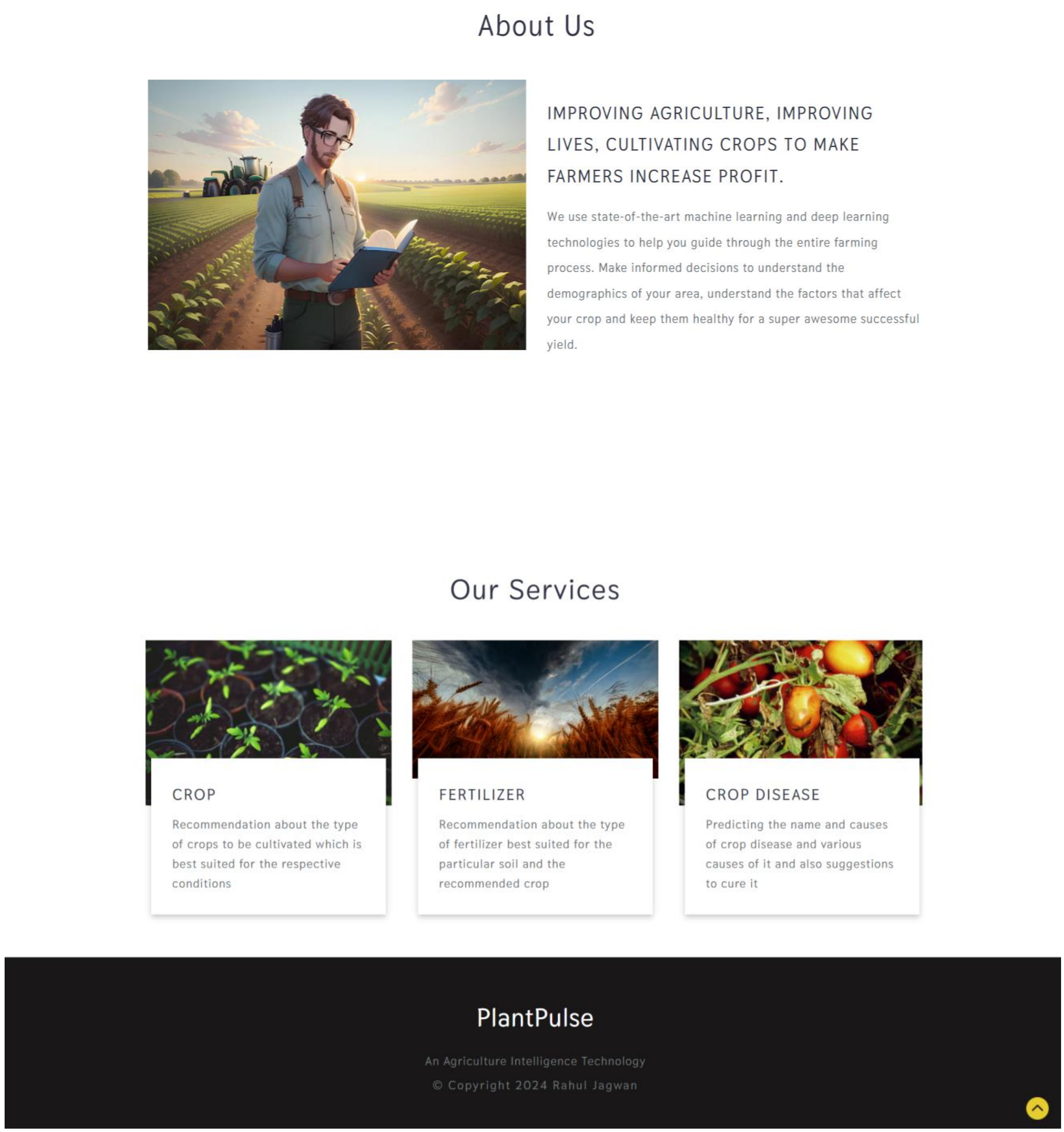
The test procedure for an agriculture crop prediction project typically involves several key steps to ensure the accuracy and reliability of the predictions. Firstly, data collection is crucial, involving the gathering of historical agricultural data such as crop yields, weather patterns, soil characteristics, and any other relevant factors. Once the data is collected, it needs to be cleaned and preprocessed to remove any inconsistencies or outliers. Next, a suitable machine learning or statistical model is selected and trained using the cleaned data, employing techniques such as regression analysis, decision trees, or neural networks. The trained model is then validated using a separate dataset to assess its performance and fine-tune any parameters if necessary. Finally, the model is tested using unseen data to evaluate its predictive ability and generalization to new scenarios. This testing phase often involves comparing the predicted crop yields against actual outcomes to measure the model's accuracy and identify any areas for improvement. Throughout the entire procedure, rigorous testing methodologies and validation techniques are employed to ensure the reliability and robustness of the crop prediction system.

6.3 Performance Outcome

The accuracy of my selected model i.e Random Forest Algorithm is 93% which is best among all the machine learning algorithms.

6.4 Output




About Us
IMPROVING AGRICULTURE, IMPROVING LIVES, CULTIVATING CROPS TO MAKE FARMERS INCREASE PROFIT.
We use state-of-the-art machine learning and deep learning technologies to help you guide through the entire farming process. Make informed decisions to understand the demographics of your area, understand the factors that affect your crop and keep them healthy for a super awesome successful yield.
Our Services
CROP
Recommendation about the type of crops to be cultivated which is best suited for the respective conditions
FERTILIZER
Recommendation about the type of fertilizer best suited for the particular soil and the recommended crop
CROP DISEASE
Predicting the name and causes of crop disease and various causes of it and also suggestions to cure it
PlantPulse
An Agriculture Intelligence Technology
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7 My learnings

Agricultural crop prediction systems leverage advanced technologies and methodologies to forecast the types and quantities of crops that can be grown under specific environmental conditions. These systems integrate data from various sources, including historical crop yields, weather patterns, soil health, and satellite imagery. By applying machine learning algorithms and data analytics, these systems can analyze complex patterns and trends to provide accurate predictions. The core of such a system often includes a robust data processing pipeline that cleans, normalizes, and augments data, followed by predictive modeling using techniques such as regression analysis, neural networks, or decision trees. Additionally, these systems may incorporate real-time data inputs for dynamic updating of predictions, ensuring they remain relevant in changing conditions. The insights generated by crop prediction systems enable farmers to make informed decisions about crop selection, planting schedules, and resource allocation, ultimately enhancing agricultural productivity, reducing waste, and contributing to food security.

8 Tools and Technologies

Programming Languages: Python, R

Data Processing: Pandas, NumPy, Scikit-learn

Visualization: Matplotlib, Seaborn, Plotly

Machine Learning Frameworks: TensorFlow, Keras, PyTorch

APIs: Flask, FastAPI

Deployment: Docker, Kubernetes, cloud services like AWS, Google Cloud Platform, Azure

9 Future work scope

The future work scope for systems in agriculture crop prediction and protection is vast and promising. With the integration of advanced technologies such as artificial intelligence, machine learning, and the Internet of Things (IoT), these systems can be significantly enhanced to provide more accurate and timely predictions. Future developments could focus on the incorporation of real-time data from various sources, including satellite imagery, weather forecasts, and soil sensors, to improve the precision of crop yield predictions and disease forecasts. Moreover, the use of big data analytics can help in identifying patterns and trends that were previously undetectable, thereby enabling proactive measures to protect crops from potential threats. Another critical area for future work is the development of user-friendly mobile applications and platforms that can deliver actionable insights to farmers in remote areas, ensuring they have access to the latest information and recommendations. Additionally, the integration of blockchain technology could offer robust solutions for traceability and transparency in the agricultural supply chain. As these systems evolve, there is also a need for continuous improvement in terms of data accuracy, algorithm efficiency, and user interface design to ensure they are accessible and beneficial to a broader range of users. Collaboration between researchers, technology developers, and agricultural experts will be crucial in driving these advancements and addressing the challenges of global food security.