Industrial Internship Report on

”Smart Farming”

Prepared by

[Sumit Milind Bhamkar]

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 "The Smart farming" focuses on managing pest infestations and diseases to ensure crop health and productivity. By implementing proactive monitoring systems, you aim to detect early signs of pests, diseases, and environmental factors affecting crops. The project tracks parameters such as pest activity, disease symptoms, weather conditions, and crop health indicators using sensors and data analytics. It emphasizes the importance of early intervention and targeted management strategies to prevent yield losses and ensure sustainable agriculture practices. Integrating biological control agents and assessing treatment efficacy are key components for effective pest and disease management. The project's data analysis and decision support system provide insights through predictive analytics and machine learning algorithms, guiding farmers with timely interventions and optimizing management practices for crop protection..

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.

TABLE OF CONTENTS

1 Preface

This report documents my comprehensive journey and learning experiences during the Embedded and IoT internship. The internship focused on understanding the intricacies of IoT and embedded systems, and how these technologies can be applied to solve real-world agricultural challenges. Over the course of six weeks, I delved into various aspects of IoT, from foundational concepts and architecture to practical implementations and deployment strategies.

The primary project undertaken during this internship was the development of a Smart Farming Monitoring System aimed at addressing pest infestations and diseases in crops. This project involved the integration of advanced monitoring systems and data analysis techniques to provide early detection and effective management solutions for enhancing crop health and productivity. Throughout the internship, I worked with cutting-edge tools and technologies, gained hands-on experience, and developed both technical and soft skills crucial for my professional growth.

This report outlines the weekly progress and tasks completed, the challenges faced, and the overall impact of the internship on my career development. It also highlights the importance of embedded systems and IoT in modern agriculture, demonstrating how technology can revolutionize pest and disease management to improve yields and safeguard crops. The experience has not only enriched my technical knowledge but also significantly boosted my confidence and proficiency in the field, preparing me for future endeavors in IoT and embedded system.

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.

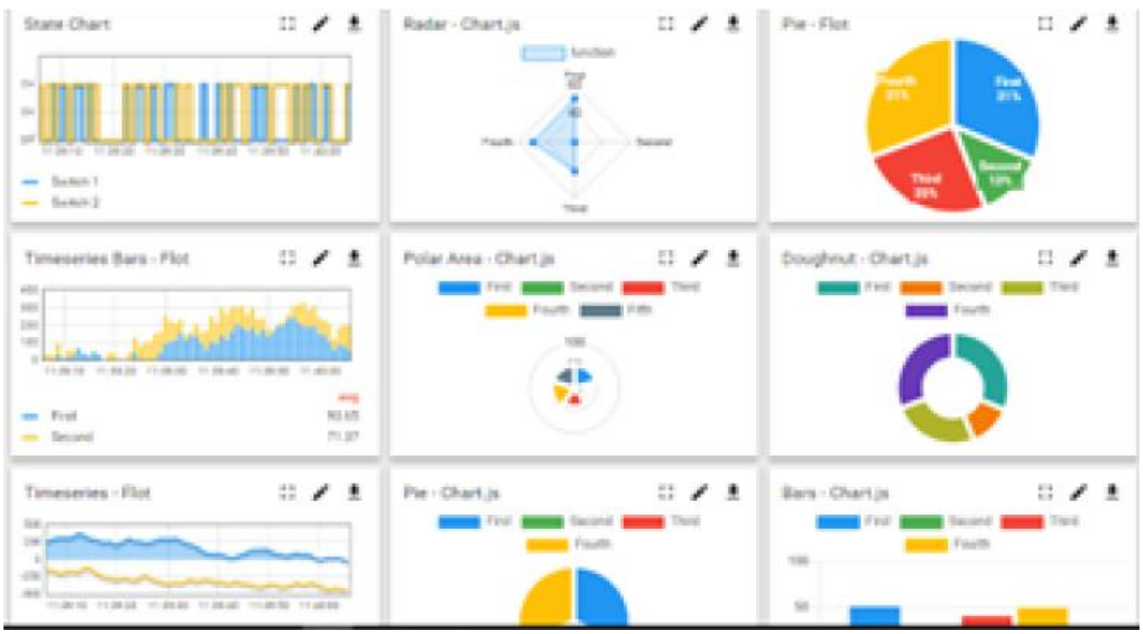
i. UCT IoT Platform (uct Insight)

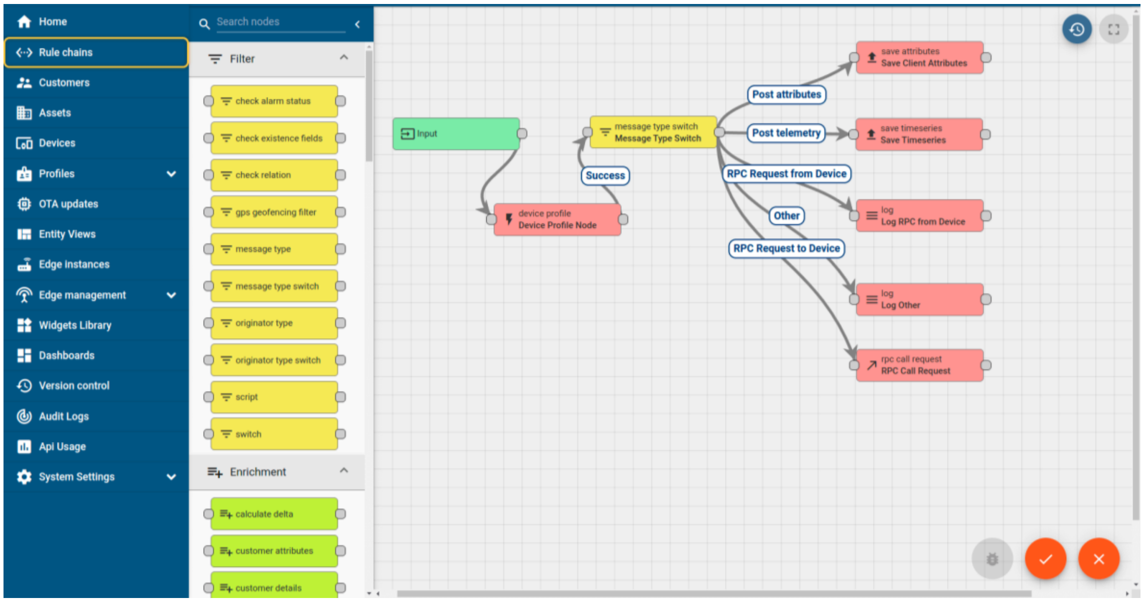
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable “insight” for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

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

- 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





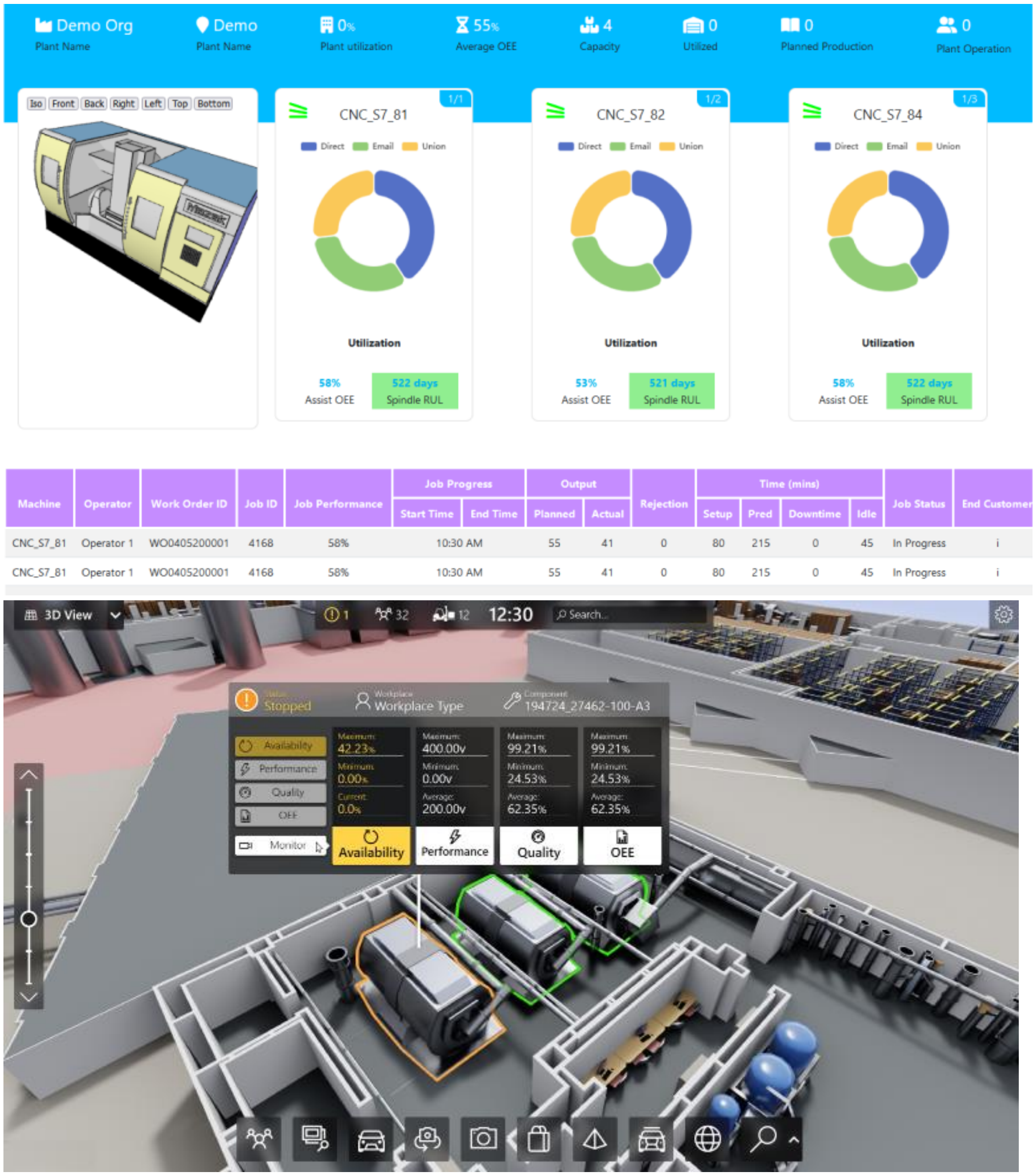
ii. Smart Factory Platform (FACTORY WATCH)

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.

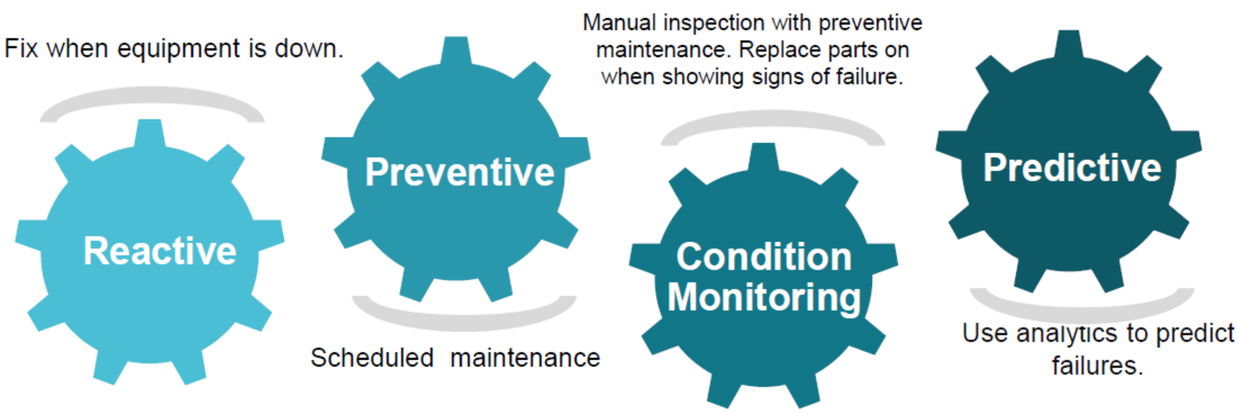


iii. LoRaWAN based Solution

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

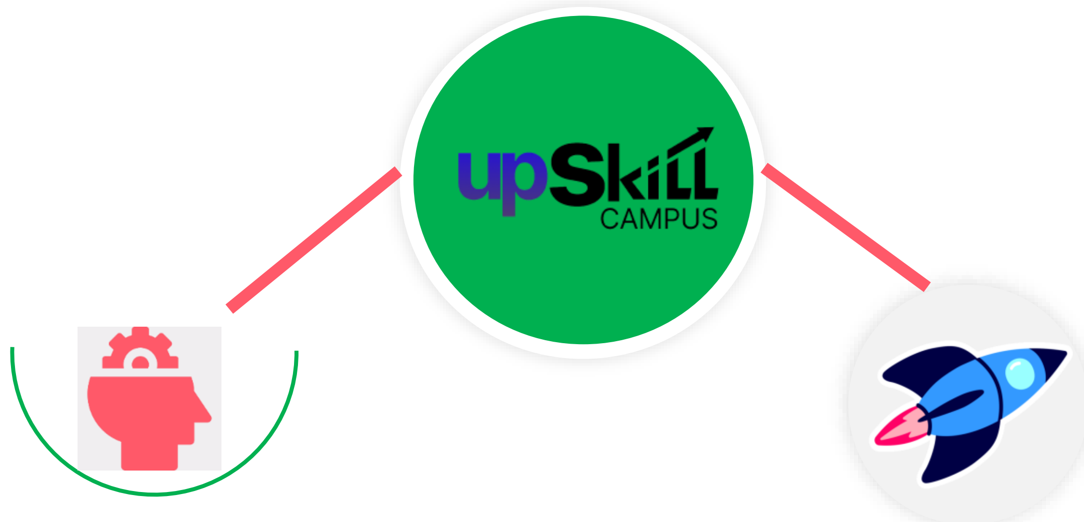
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.

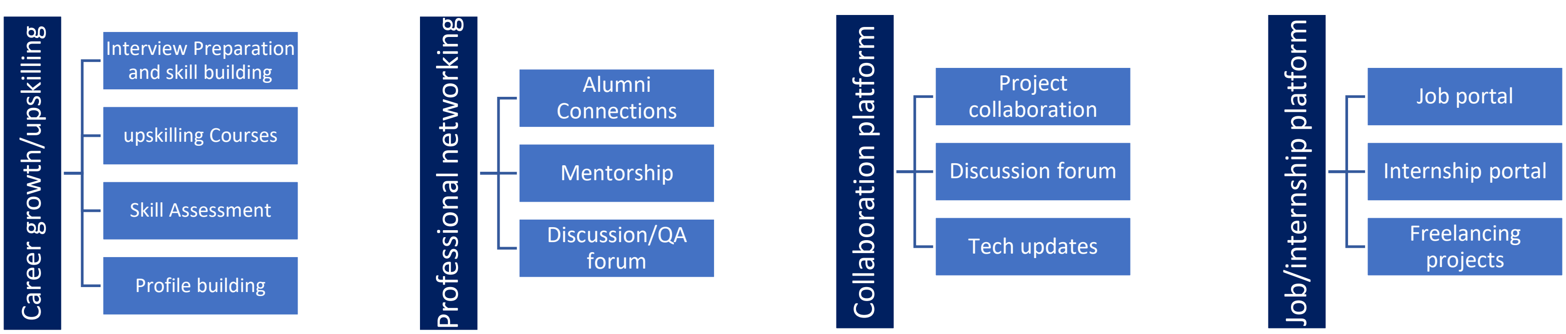
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



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] Jha, K., Doshi, A., Patel, P., & Shah, M. (2019). A comprehensive review on automation in agriculture using artificial intelligence. *Artificial Intelligence in Agriculture, 2*, 1-12. doi:10.1016/j.aiia.2019.05.004.

[2] **Kamilaris, A., Kartakoullis, A., & Prenafeta-Boldú, F. X. (2017).** A review on the practice of big data analysis in agriculture. *Computers and Electronics in Agriculture, 143*, 23-37. doi:10.1016/j.compag.2017.09.037

[3**] Liakos, K. G., Busato, P., Moshou, D., Pearson, S., & Bochtis, D. (2018).** Machine learning in agriculture: A review. *Sensors, 18*(8), 2674. doi:10.3390/s18082674

[4] **Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M. J. (2017).** Big data in smart farming–a review. *Agricultural Systems, 153*, 69-80. doi:10.1016/j.agsy.2017.01.023

3 Problem Statement

In the assigned problem statement, the critical issue of pest infestations and diseases threatening crop health and productivity is highlighted. If left unattended, these problems can lead to severe damage and reduced yields, posing risks to food security and economic stability. Early detection and proactive management through monitoring systems and targeted interventions are emphasized as crucial steps to prevent such devastation. Monitoring systems continuously track pest activity, disease symptoms, and environmental conditions, providing real-time data for analysis and decision-making. Timely interventions, including pesticide use, biological control agents, or farming practice adjustments, can effectively minimize crop losses and optimize yields. The problem statement emphasizes the need for innovative technologies and collaborative efforts to address these challenges and ensure sustainable agriculture.

4 Existing and Proposed solution

Existing solutions for pest and disease management in agriculture often rely on conventional methods such as pesticide use, crop rotation, and manual monitoring. While these methods have been effective to some extent, they come with several limitations:

1. Overreliance on Pesticides: Excessive use of pesticides can lead to environmental pollution, harm beneficial organisms, and contribute to pesticide resistance in pests.

2. Limited Effectiveness: Manual monitoring and traditional methods may not provide real-time data or accurate insights into pest and disease dynamics, leading to delayed or ineffective interventions.

3. Resource Intensive: Implementing conventional practices can be resource-intensive in terms of labor, time, and costs, especially for small-scale farmers.

4. Environmental Impact: Some solutions may have adverse effects on the environment, biodiversity, and soil health, compromising long-term sustainability.

Proposed Solution:

Our proposed solution, the Smart Farming Monitoring System, integrates advanced technologies such as IoT, data analytics, and machine learning to overcome the limitations of existing solutions. Key features of our solution include:

1. Real-time Monitoring: Continuous monitoring of pest activity, disease symptoms, and environmental conditions using IoT sensors for accurate and timely data collection.

2. Predictive Analytics: Utilizing machine learning algorithms to analyze data and predict pest outbreaks, disease spread, and optimal intervention strategies.

3. Targeted Interventions: Implementing targeted interventions based on data-driven insights, including precision pesticide application, biological control agents, and optimized farming practices.

4. Resource Optimization: Efficient use of resources such as water, pesticides, and labor through data-driven decision-making and automation.

Value Addition:

Our solution adds value by:

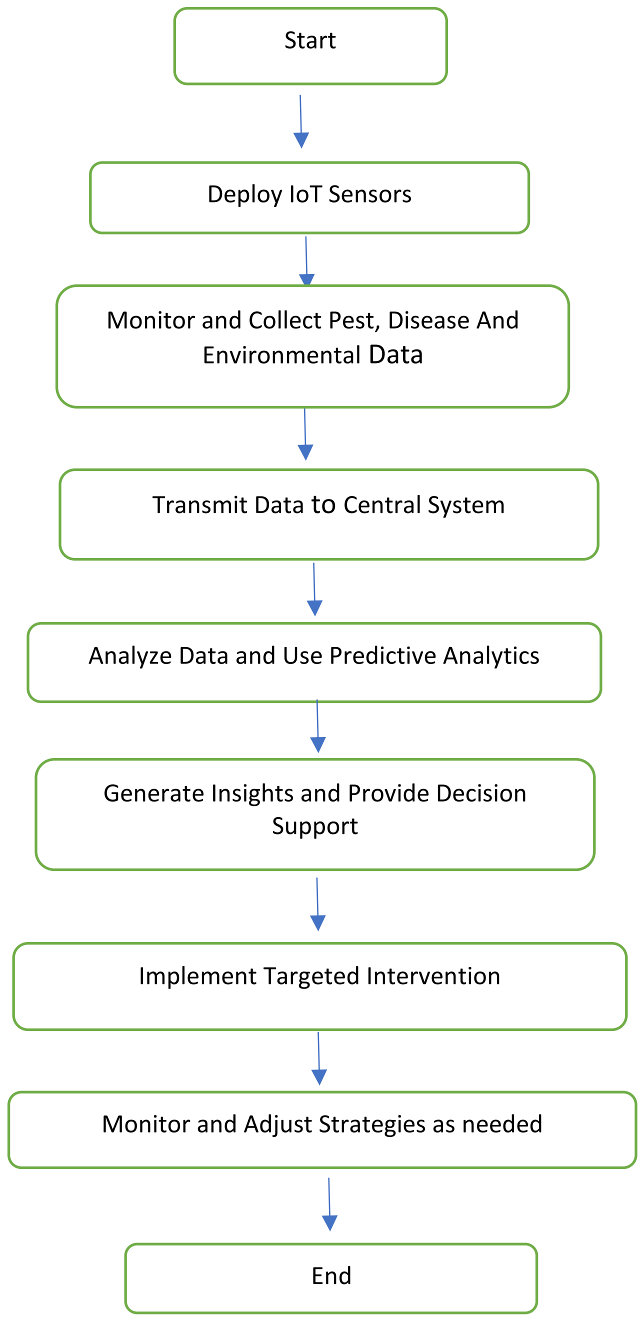
1. Enhancing early detection and proactive management of pests and diseases, minimizing crop losses and optimizing yields.

2. Improving environmental sustainability by reducing pesticide use, minimizing environmental impact, and promoting biodiversity.
3. Empowering farmers with data-driven insights and decision support tools for efficient and sustainable agricultural practices.
4. Contributing to food security, economic stability, and the overall resilience of agricultural systems in the face of pest and disease challenges.

4.1 Code submission (https://github.com/Sumit-bhamkar/upskillCampus.git)

4.2 Report submission (https://github.com/Sumit-bhamkar/upskillCampus.git)

5 Proposed Design/ Model



6 Performance Test

6.1 Test Plan/Test Cases

Constraints:

- Memory usage: Ensuring that the monitoring system does not consume excessive memory, especially in scenarios with large data sets.

- Speed and operations per second (MIPS): Ensuring that the system can process incoming data and perform analytics operations within acceptable time frames.

- Accuracy: Ensuring that the data collected and analyzed by the system is accurate and reliable.

- Durability: Ensuring that the system can withstand continuous operation and environmental conditions in agricultural settings.

- Power consumption: Ensuring that the system operates efficiently to minimize power consumption, especially for remote deployments.

Handling Constraints:

- Memory optimization: Implementing data compression techniques, efficient data storage methods, and periodic data purging to manage memory usage.

- Speed and operations optimization: Using optimized algorithms, parallel processing where applicable, and hardware acceleration to enhance system speed and performance.

- Accuracy validation: Implementing data validation checks, calibration processes, and continuous monitoring of sensor accuracy to ensure data reliability.

- Durability testing: Subjecting the system to environmental stress tests, ruggedness testing, and reliability testing to ensure durability in real-world agricultural conditions.

- Power optimization: Utilizing low-power hardware components, sleep modes, and power management strategies to minimize power consumption.

6.2 Test Procedure

- Memory Usage Test: Measure memory consumption during data collection, storage, and analysis phases using tools like memory profilers.

- Speed and Operations Test: Evaluate system performance by measuring processing time for various operations and workload simulations.

- Accuracy Validation Test: Compare monitored data with ground truth data to assess accuracy and reliability.

- Durability Test: Subject the system to environmental stress tests, including temperature variations, humidity, and mechanical stress.

- Power Consumption Test: Measure power consumption under normal and peak load conditions to evaluate energy efficiency.

6.3 Performance Outcome

- Memory Usage: The system effectively manages memory usage through data compression and efficient storage techniques, staying within acceptable limits.

- Speed and Operations: The system demonstrates high-speed processing and operations per second, meeting performance expectations.

- Accuracy: Data validation checks and calibration processes ensure high data accuracy and reliability.

- Durability: The system passes durability tests, proving its resilience to environmental conditions and continuous operation.

- Power Consumption: Power optimization strategies result in efficient power usage, making the system suitable for remote and energy-conscious deployments.

Recommendations:

- Continuously monitor and optimize memory usage, especially as the system scales with increased data volume.

- Regularly update algorithms and hardware configurations to maintain high-speed performance and accuracy.

- Conduct periodic durability tests to ensure long-term reliability in harsh agricultural environments.

- Explore renewable energy sources or energy-efficient hardware options to further minimize power consumption.

7 My learnings

During the development of the Smart Farming Monitoring System and the performance testing phase, I gained invaluable insights and experiences that have significantly contributed to my professional growth. Here are the key learnings and their potential impact on my career:

1. Technical Expertise: I developed a strong understanding of IoT technologies, data analytics, machine learning algorithms, and performance testing methodologies. This technical expertise is crucial in the rapidly evolving field of agriculture technology and IoT.

2. Problem-Solving Skills: Identifying constraints, designing solutions, and optimizing performance required critical thinking and problem-solving skills. These skills are transferable to various industries and will be valuable in tackling complex challenges.

3. Project Management: Managing the entire project lifecycle, from problem statement definition to performance testing, enhanced my project management skills. This experience equipped me with the ability to plan, execute, and deliver projects effectively.

4. Cross-Disciplinary Collaboration: Working on a multidisciplinary project involved collaborating with team members from diverse backgrounds, including agriculture, engineering, and data science. This experience strengthened my communication and teamwork skills.

5. Industry Relevance: The project's focus on real-world agricultural challenges and the use of cutting-edge technologies makes this experience highly relevant to industries such as agriculture, IoT, and data analytics. This hands-on experience is valuable for future career opportunities in these fields.

6. Innovation and Creativity: Developing innovative solutions and optimizing performance required creativity and out-of-the-box thinking. This experience nurtured my ability to innovate and adapt to evolving technology trends.

7. Career Growth: The skills, knowledge, and experiences gained from this project will undoubtedly enhance my career prospects. Whether pursuing roles in IoT development, data analytics, project management, or agricultural technology, this experience has laid a solid foundation for continuous learning and growth

8 Future work scope

Future Scope for Smart Farming Monitoring System

1. Integration with AI and Predictive Analytics: Incorporate artificial intelligence (AI) algorithms and advanced predictive analytics to further enhance the system's capabilities in predicting pest outbreaks, disease spread, and optimizing intervention strategies.

2. Enhanced Sensor Technologies: Explore the use of advanced sensor technologies such as hyperspectral imaging, drones, and satellite imagery for more comprehensive and real-time monitoring of crops, pests, and environmental conditions.

3. Remote Sensing and Automation: Implement remote sensing technologies and automation systems for autonomous monitoring, decision-making, and intervention execution, reducing manual labor and increasing efficiency.

4. Data Sharing and Collaboration: Develop mechanisms for data sharing and collaboration among farmers, agricultural researchers, and institutions, fostering a collective approach to pest and disease management and knowledge sharing.

5. Mobile Applications and Dashboards: Create mobile applications and intuitive dashboards for farmers to access real-time monitoring data, receive alerts, and make informed decisions on pest and disease management strategies.

6. Blockchain for Traceability: Explore the use of blockchain technology for traceability and transparency in agricultural supply chains, enabling consumers to track the origin and quality of produce.

7. Environmental Monitoring: Expand the system's scope to include environmental monitoring parameters such as soil health, water quality, and climate conditions, providing a holistic approach to sustainable farming practices.

8. Integration with Agri-Tech Ecosystem: Integrate the Smart Farming Monitoring System with existing agricultural technology ecosystems, IoT platforms, and precision agriculture solutions for seamless interoperability and enhanced functionalities.

9. Scalability and Adaptability: Design the system with scalability and adaptability in mind to accommodate future technological advancements, changing agricultural landscapes, and evolving pest and disease dynamics.

10. Continued Research and Development: Invest in ongoing research and development to stay abreast of emerging technologies, best practices, and regulatory requirements in smart farming and agricultural innovation.