Industrial Internship Report on

”Crop recomendation system”

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 focused on solving a real-world problem. My project was **Crop Recommendation System**, which uses environmental parameters and machine learning to recommend the best crop for a given region. This internship gave me a valuable opportunity to get exposure to industrial challenges and develop a practical solution. It was an excellent learning experience.

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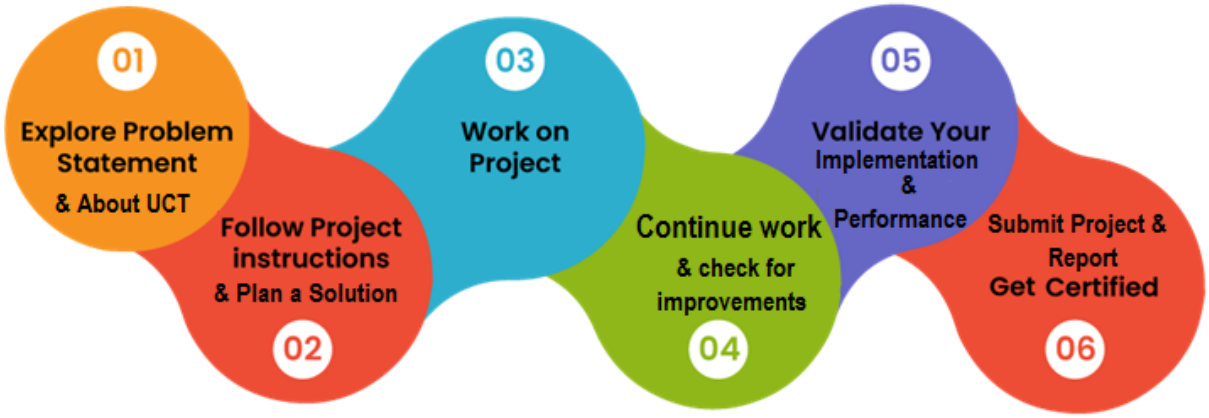
1 Preface

Over the course of six weeks, I worked on a machine learning-based project titled **Crop Recommendation System**. This internship was a great opportunity to apply academic knowledge to a real-world use case. I learned how to clean data, train predictive models, evaluate performance, and document my findings. I sincerely thank **upskill Campus, The IoT Academy**, and **UCT** for providing me with this valuable platform. I also thank my mentors and peers who helped me directly or indirectly. To my juniors, I highly recommend participating in such internships to improve your skills and confidence.



During this internship, I gained practical exposure to real-world applications of machine learning and improved my understanding of how technology can directly benefit sectors like agriculture. I learned how to handle datasets, perform preprocessing, implement ML models, and evaluate their performance. This experience also strengthened my problem-solving skills, teamwork, and documentation abilities.

I would like to sincerely thank the **upskill Campus**, **The IoT Academy**, and **UniConverge Technologies Pvt Ltd (UCT)** for organizing this valuable internship. A special thanks to all the mentors and coordinators who guided me throughout this journey. I also extend my gratitude to my friends and teammates who supported me, directly or indirectly, during this project.

To my juniors and peers, I encourage you to actively take part in internships and hands-on projects. These experiences not only build technical skills but also enhance your confidence to tackle real-world challenges. Always stay curious, keep learning, and never hesitate to explore beyond your comfort zone.

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.

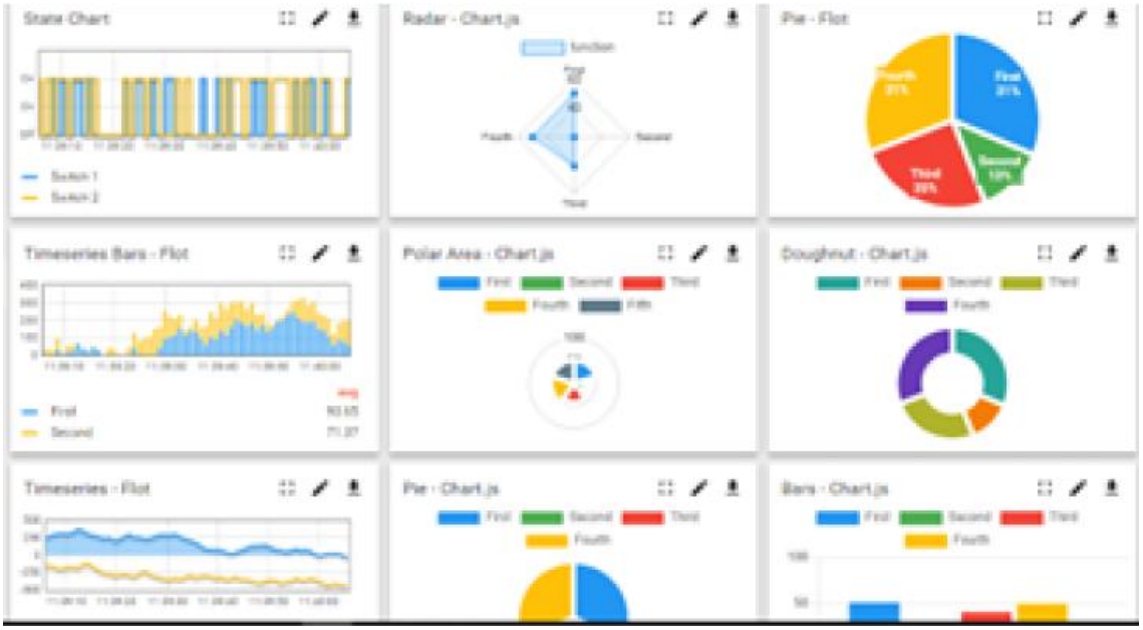
i. UCT IoT Platform (UCT Insight)

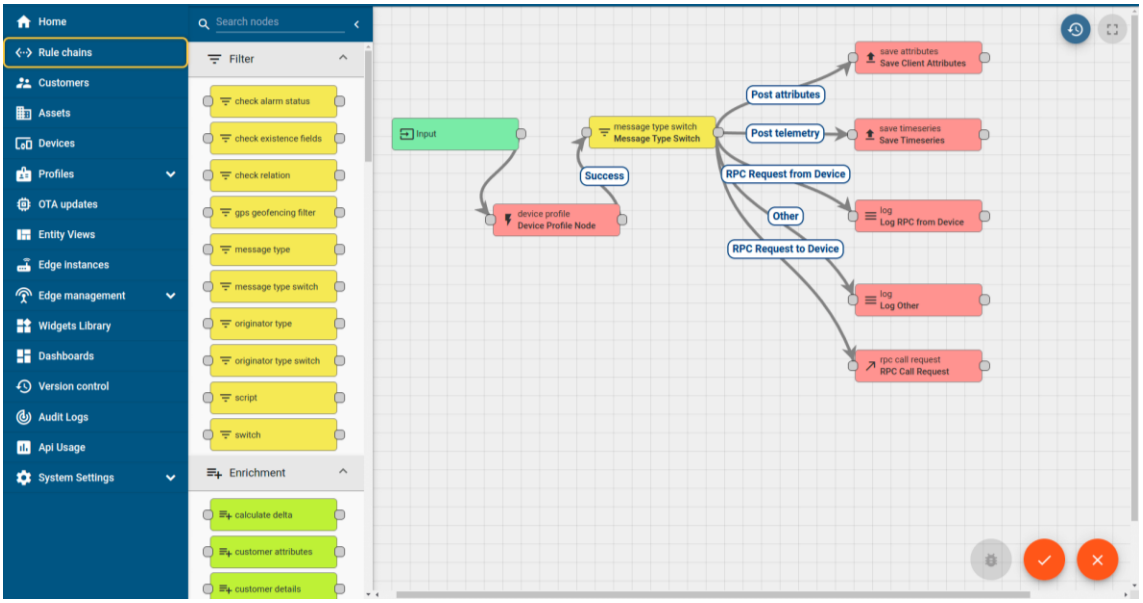
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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.

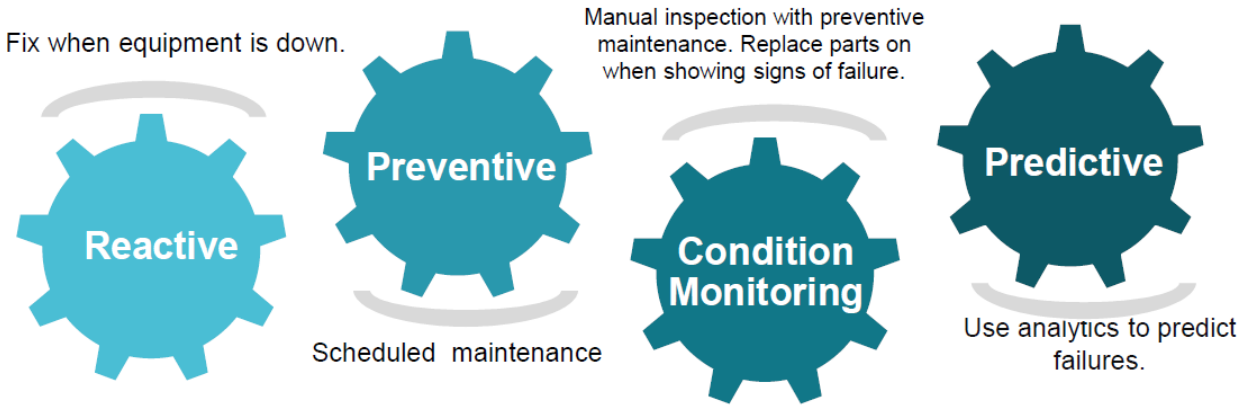
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1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

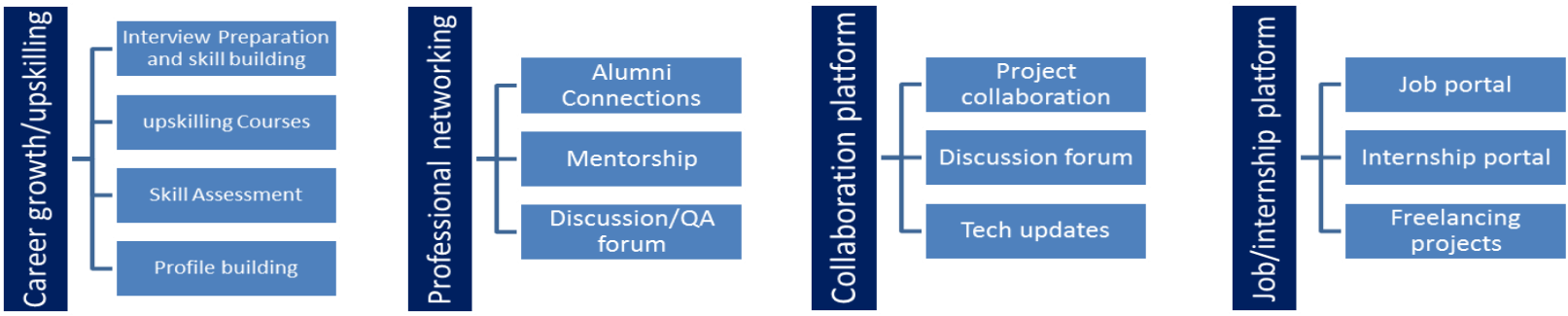
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.



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

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2.6 Glossary

Terms	Acronym

3 Problem Statement

Agriculture plays a critical role in the Indian economy, with a majority of the rural population depending on it for their livelihood. However, farmers often face challenges in deciding which crop to cultivate, especially when dealing with changing weather patterns, unpredictable soil conditions, and lack of access to scientific decision-making tools. The selection of the wrong crop for a given soil and climate condition can result in poor yield, economic loss, and resource wastage. Traditional practices of crop selection are based on intuition and past experiences, which may not always align with current environmental conditions.

To address this issue, there is a pressing need for a data-driven solution that helps farmers make informed decisions about crop selection. The objective of this project is to develop a **Machine Learning-based Crop Recommendation System** that can suggest the most suitable crop based on various environmental and soil parameters. The dataset used for this purpose includes key features such as nitrogen (N), phosphorus (P), potassium (K), temperature, humidity, pH, and rainfall.

By analyzing historical crop data and environmental factors, the system will predict the most appropriate crop to cultivate in a specific region. The system will be trained using supervised learning techniques, and multiple models will be tested for accuracy and efficiency. The goal is to maximize crop productivity, reduce input costs, and provide personalized agricultural recommendations to farmers through an automated and scalable solution.

This problem statement aligns with the broader mission of promoting smart agriculture using modern technologies like Artificial Intelligence and Machine Learning. It empowers farmers with insights that were previously unavailable or difficult to interpret without technical knowledge. If implemented effectively, this system can contribute significantly to improving food security, optimizing resource use, and boosting the overall agricultural output in data-scarce and underserved farming communities.

4 Existing and Proposed solution

- **Existing Solutions and Limitations**

In traditional farming practices, crop selection is largely based on the experience of farmers, local knowledge, and seasonal assumptions. While this has been the foundation of agriculture for centuries, it comes with several limitations in the modern context:

1. **Lack of Data-Driven Decisions**: Most farmers rely on historical patterns and anecdotal knowledge, which may not reflect current soil or weather conditions accurately.
2. **Inefficient Resource Utilization**: Planting unsuitable crops can lead to overuse of fertilizers, water, and pesticides, impacting both yield and the environment.
3. **Reduced Productivity**: Crops that are mismatched with soil nutrients or climatic conditions may fail to thrive, resulting in lower yield and income loss.
4. **Climate Change Impact**: Unpredictable weather patterns and rainfall due to climate change are not easily accounted for in traditional methods.
5. **Limited Expert Access**: Small and marginal farmers often do not have access to agronomists or scientific tools for soil analysis and crop advisory.

Some digital tools have been introduced in the recent decade, such as agricultural extension apps or basic soil testing kits, but these are either too generic, lack personalization, or require manual interpretation. They often do not integrate machine learning or predictive models for intelligent recommendations.

- **Proposed Solution – Crop Recommendation System using Machine Learning**

To address the above limitations, we propose a **Crop Recommendation System (CRS)** that leverages **supervised machine learning algorithms** to predict the best crop to cultivate based on key environmental and soil features. These include:

- **Nitrogen (N)**
- **Phosphorus (P)**
- **Potassium (K)**
- **Temperature**

- **Humidity**
- **pH**
- **Rainfall**

Using a publicly available dataset from Kaggle, we trained various ML models, including:

- Decision Tree Classifier
- Random Forest Classifier
- Support Vector Machines (SVM)
- K-Nearest Neighbors (KNN)

Each model was evaluated using standard metrics such as accuracy, precision, recall, and F1-score. Among these, the **Random Forest Classifier** showed the highest accuracy (~96%) and was selected as the primary model.

- **Value Addition of the Proposed System**

The proposed solution offers significant improvements over existing methods:

- **Data-Driven Recommendations**: Unlike traditional practices, our system makes crop decisions based on quantifiable soil and weather data.
- **Scalability and Automation**: Once deployed, the system can be accessed by multiple users and can handle large-scale predictions without manual intervention.
- **Personalization**: The model provides tailored crop recommendations based on specific inputs, which can vary from farm to farm.
- **Open-Source and Cost-Effective**: By making the code available via GitHub and using open-source Python libraries (like Scikit-learn, Pandas, and NumPy), the project can be freely used or extended.
- **Farmer Empowerment**: With proper UI integration, this system can be converted into a mobile/web app that farmers can use directly with minimal training.

- **Future Enhancement Possibilities**

To improve real-world usability, the system can be further enhanced by:

- Integrating real-time weather API data for more accurate recommendations.
- Building a front-end interface (web/mobile) for farmer accessibility.
- Including additional parameters like soil moisture, elevation, or fertilizer type.
- Expanding to multi-language support and regional crop datasets.
- Adding recommendation for fertilizer and irrigation scheduling.

4.1 Report submission (Github link) :

https://github.com/dhanushm18/upskillcampus.git

5 Proposed Design/ Model

The design process followed these stages:

1. **Data Collection** – from Kaggle's crop recommendation dataset.
2. **Preprocessing** – data cleaning, label encoding, and scaling.
3. **Model Training** – tested multiple algorithms.
4. **Evaluation** – used accuracy, precision, and confusion matrix.
5. **Result** – Random Forest gave ~96% accuracy.

5.1 High Level Diagram

Soil/Weather Data → Preprocessing → ML Model → Recommended Crop

Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

5.2 Interfaces (if applicable)

Update with Block Diagrams, Data flow, protocols, FLOW Charts, State Machines, Memory Buffer Management.

6 Performance Test

Constraints:

- Accuracy
- Runtime performance
- Generalizability

Test Plan:

- Trained with 80:20 split
- Used cross-validation and evaluation metrics

Outcome:
Random Forest classifier outperformed others with ~96% accuracy. Model is suitable for practical use cases.

7 My learnings

Through this internship, I improved my skills in:

- Machine Learning using Python
- Libraries like Scikit-learn, Pandas, Matplotlib
- Data cleaning and visualization
- Problem-solving and real-world application of AI
- Documentation and GitHub project management

8 Future work scope

1. integration with real-time APIs for rainfall, temperature, etc.
2. Develop a user interface or mobile app for farmers
3. Add fertilizer and irrigation recommendations
4. Deploy as a web app using Flask or Django