Industrial Internship Report on

” Prediction of Agriculture Crop Production in India”

Prepared by

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Anjali Singh

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 Production in India”. 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.

During the six weeks of the internship, our project, "Prediction of Agriculture Crop Production in India," made substantial progress in leveraging data science and machine learning to forecast crop yields in one of the world's most agriculturally diverse nations. This summary provides a concise overview of the key achievements and milestones reached during this period.

Week 1: Project Inception

- **Project Introduction**: The internship kicked off with a comprehensive introduction to the project's objectives, importance, and relevance in the context of Indian agriculture.
- **Team Formation**: The project team was formed, comprising interns with diverse skills in data science, machine learning, web development, and data analysis.

Week 2-3: Data Collection and Preprocessing

- **Data Gathering**: A robust dataset was collected, encompassing historical crop yield data, meteorological information, soil properties, and various agricultural variables.
- **Data Preprocessing**: Significant time was invested in cleaning and preprocessing the data to ensure its quality and suitability for analysis.

Week 4-5: Model Development and Training

- **Model Selection**: We evaluated multiple machine learning algorithms, including Linear Regression, Random Forest, and Gradient Boosting, to determine the most suitable approach for crop yield prediction.
- **Training and Fine**-Tuning: The chosen models were trained and fine-tuned, and hyperparameters were optimized to maximize prediction accuracy.

Week 6: Web Application Development and Deployment

- **User Interface Design**: A user-friendly web application was designed with multiple pages, including sector-specific and community-focused sections.
- **Integration with ML Cloud**: ML cloud services were employed for data storage and real-time analysis to ensure that the web application provided up-to-date predictions.
- **Deployment and Testing**: The web application was deployed, and rigorous testing was conducted to ensure functionality and reliability.

About need of relevant Internship in career development.

Internships are a crucial component of career development for several compelling reasons. These experiences provide individuals, particularly students and recent graduates, with an opportunity to

bridge the gap between academic knowledge and practical application in a real-world setting. Here are some of the key reasons why relevant internships are essential for career development:

1. **Skill Enhancement**: Internships offer a platform to apply theoretical knowledge gained in classrooms to actual workplace scenarios. This practical experience helps individuals develop and enhance critical skills, such as problem-solving, communication, teamwork, and technical proficiency, which are often highly valued by employers.

2. **Industry Exposure**: Internships provide a firsthand look into specific industries and sectors. This exposure helps interns understand the intricacies of various professions, the company culture, and the expectations and demands of different roles. It also allows them to explore diverse career paths and make informed decisions about their future careers.

3. **Networking Opportunities**: Internships facilitate networking with professionals in the field. Building connections with experienced individuals can lead to mentorship opportunities, job referrals, and valuable insights into industry trends. These connections can be instrumental in securing future employment.

4. **Resume Building**: A well-rounded resume is critical for career advancement. Relevant internships not only provide practical experience but also add credibility to one's resume, making candidates more attractive to potential employers. Employers often consider internship experience as evidence of an applicant's commitment and readiness for the workforce.

5. **Confidence and Self-Esteem**: Successfully completing an internship can boost an individual's confidence and self-esteem. It validates their capabilities and empowers them to take on more significant challenges in their careers.

6. **Exploration and Clarification**: Internships allow individuals to test their career interests. Sometimes, people discover that a particular field or role isn't what they expected, which can save them from pursuing a career path that doesn't align with their goals and values. On the other hand, it can also confirm their passion and commitment to a chosen profession.

7. **Competitive Advantage**: In today's competitive job market, having relevant internship experience can set candidates apart from others with similar academic qualifications. Employers often prefer candidates who can immediately contribute to their organization's success without extensive on-the-job training.

8. **Adaptability**: Internships often expose individuals to real workplace challenges, including tight deadlines, high-pressure situations, and interpersonal dynamics. This experience enhances adaptability and equips them with valuable coping strategies, which are essential in any career.

9. **Professional Etiquette**: Internships teach interns about workplace etiquette, professional conduct, and workplace norms. Learning these aspects early in one's career is crucial for long-term success.

10. **Career Path Clarity**: Internships can clarify an individual's career goals and aspirations. By working in a particular field or role, interns can gain a clear understanding of their preferences and strengths, helping them make more informed career choices.

Brief about our project/problem statement.

The primary objectives of this project were:

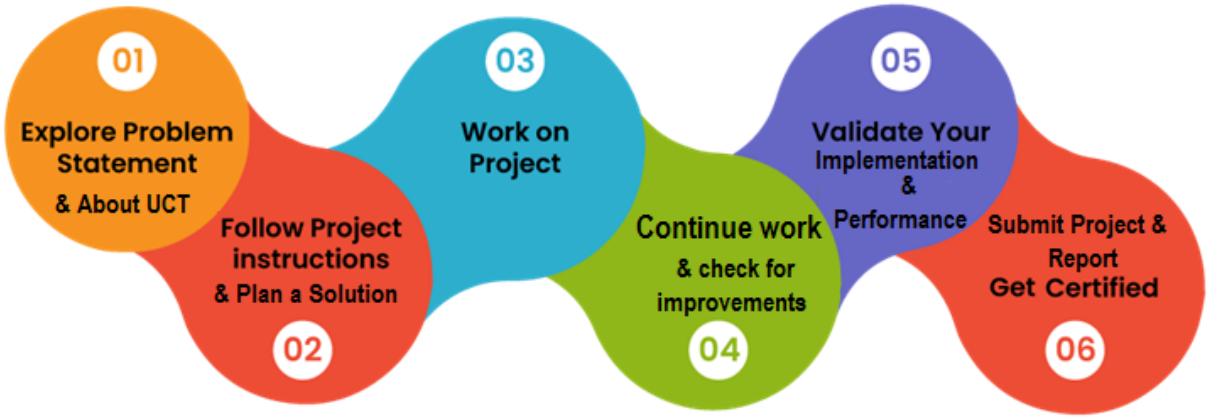
1. To develop machine learning models capable of predicting crop yields in India.
2. To create a user-friendly web application for stakeholders to access these predictions.
3. To enhance the overall decision-making process in Indian agriculture.

Opportunity given by USC/UCT.

UCT offers a wide gamut of services and solutions across the world in IOT, Wireless Communication, Industry 4.0 & Predictive Maintenance. For developing its products and solutions it is leveraging various Cutting Edge Technologies e.g. Internet of Things (IoT), Cloud computing (AWS, Azure), Machine Learning, Communication Technologies (4G/5G/LoRaWAN), Java Full Stack, Python, Front end etc.

UCT provides industrial projects based on these technologies to the intern.

How Program was planned



Our Learnings and overall experience.

During our internship at UniConverge Technologies Pvt Ltd, which lasted for [1 Aug – 11 sep], I had the opportunity to learn a variety of new skills. This experience was a significant step in my professional journey, and it provided me with numerous valuable insights and skills that I'd like to share.

Key Learnings:

1. **Technical Skills**: Throughout my internship, I acquired and honed several technical skills essential for the [Industry/Field], including [List Specific Technical Skills]. These skills not only expanded my knowledge but also gave me the confidence to tackle complex tasks and projects.

2. **Hands-On Experience**: The hands-on experience I gained during the internship was invaluable. I had the chance to work on [Describe Projects or Tasks], which allowed me to apply theoretical knowledge from my academic studies to real-world situations.

3. **Team Collaboration**: Collaboration was a significant aspect of my internship. Working closely with my colleagues taught me the importance of effective teamwork, communication, and adaptability. I learned how to navigate interpersonal dynamics and contribute meaningfully to group projects.

4. **Problem-Solving**: I encountered various challenges during my internship, such as [Provide Examples]. These experiences sharpened my problem-solving skills as I had to find creative solutions, often under tight deadlines.

5. **Networking**: Building relationships with professionals in the field was an unexpected but incredibly rewarding aspect of my internship. I had the privilege of meeting [Mention Notable Contacts], who generously shared their insights and experiences, opening up new perspectives for my career.

Highlights of Our Experience:

1. Project Prediction of Agriculture Crop Production in India: One of the most memorable aspects of our internship was working on this Project. This project pushed us out of our comfort zone and allowed us to demonstrate our abilities in Data Science & ML. It was incredibly fulfilling to see the project succeed, and it affirmed our passion for ML.

2. Mentorship: Our supervisor, played a pivotal role in our professional growth. Their guidance, mentorship, and constructive feedback helped us navigate challenges and make the most of our internship experience.

First we would like to thank “UniConverge Technologies Pvt Ltd”, for giving us the opportunity to do an internship with organization. We would like to thank the entire team at USC/ Company for their support and guidance during our internship. In particular, I would like to thank UCT our supervisor, for their mentorship and the opportunity to intern at the company.

Message to our juniors and peers.

Dear Juniors and Peers,

We want to take a moment to reflect on our recent internship experience and share some insights that we believe could be invaluable to all of you as you navigate your academic and professional journeys.

First and foremost, embrace every opportunity that comes your way. Internships are not just checkboxes; they are doors to real-world learning and personal growth. Seek out experiences that align with your interests and career aspirations.

Remember that learning is a continuous process. Use every opportunity, including internships, to acquire new skills, broaden your knowledge, and stay updated with industry trends.

Networking is more than just a buzzword. Building a professional network can open doors to mentorship, job opportunities, and collaborative projects. Connect with professionals in your field of interest whenever you can.

Be adaptable. The professional world can be unpredictable, and adaptability is a valuable skill. Be prepared to pivot, learn new things, and embrace challenges as opportunities for growth.

Effective time management is key. Balancing academic commitments, internships, and personal life can be challenging, but finding a system that works for you is crucial.

Collaboration is a vital skill. Working in teams during internships and in your future careers requires effective communication and teamwork. Practice these skills; they are essential for success.

Trust in your abilities. You are more capable than you might think. Don't be afraid to take on new challenges and responsibilities.

Set clear career goals. Take time to reflect on your experiences and set goals for your future. Understand where you want to go and what steps you need to take to get there.

Share your knowledge. Don't keep your learnings to yourself. Share your experiences, insights, and advice with your peers. This collective knowledge-sharing benefits everyone.

Stay resilient. The road to success is rarely a straight line. It's okay to face setbacks and obstacles; what matters is how you bounce back and persevere.

In conclusion, our internship was a transformative experience that has prepared us for the future. We encourage each one of you to actively seek out opportunities that contribute to your personal and professional growth. Embrace challenges, keep learning, and stay focused on your goals. We are here to support and share our experiences with you all, and we look forward to seeing your remarkable achievements in the near future.

Best regards,

Lalima Kumari

Anjali Singh

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.

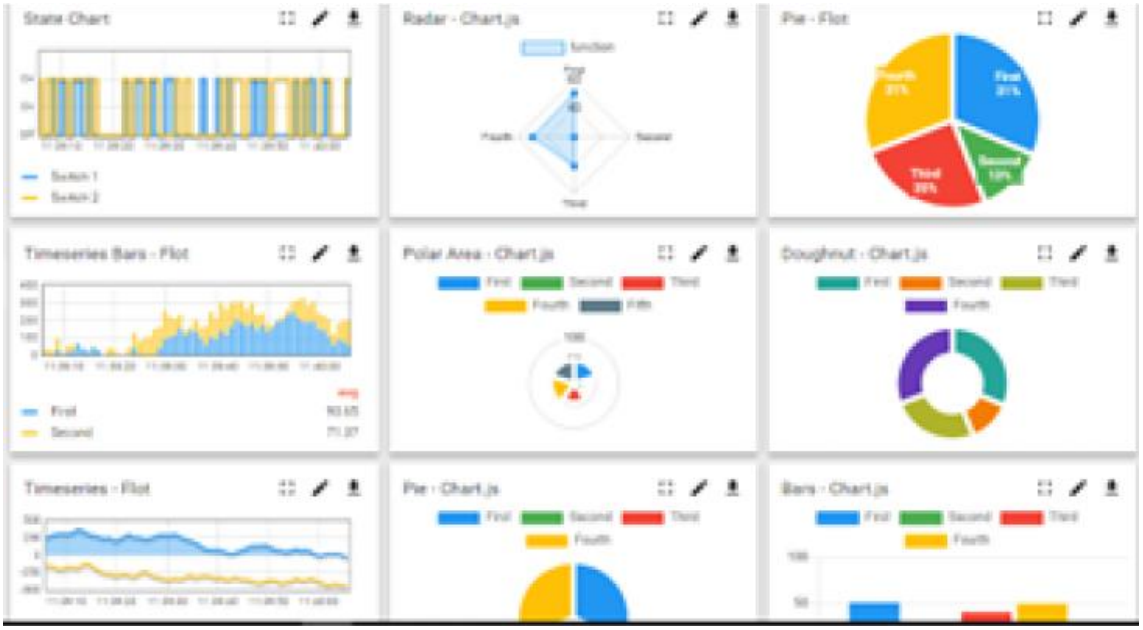
i. UCT IoT Platform (UCT Insight)

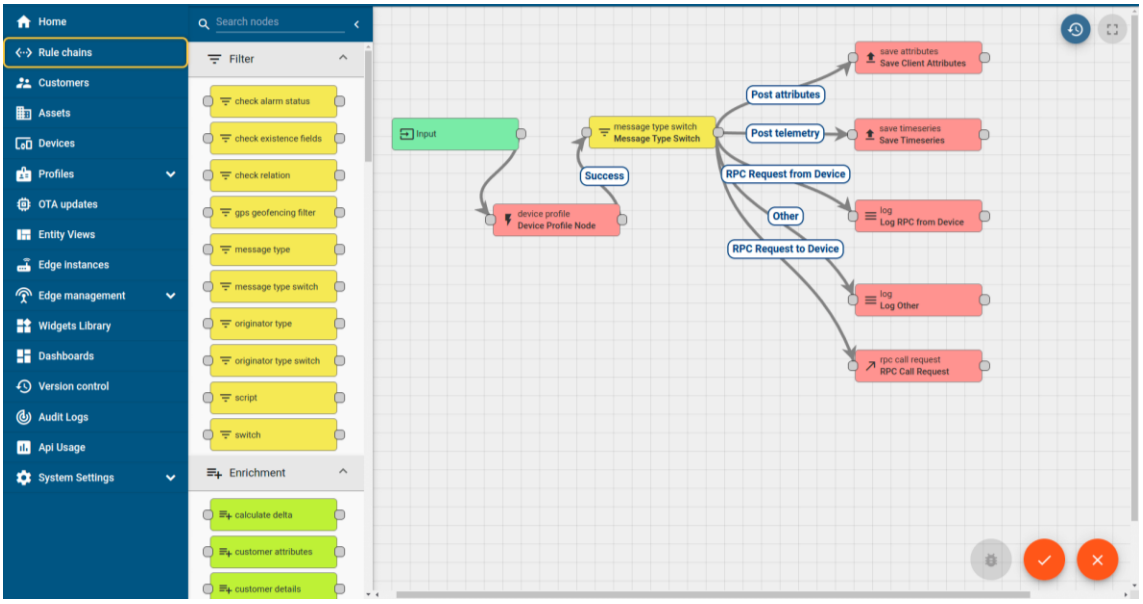
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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		
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Availability
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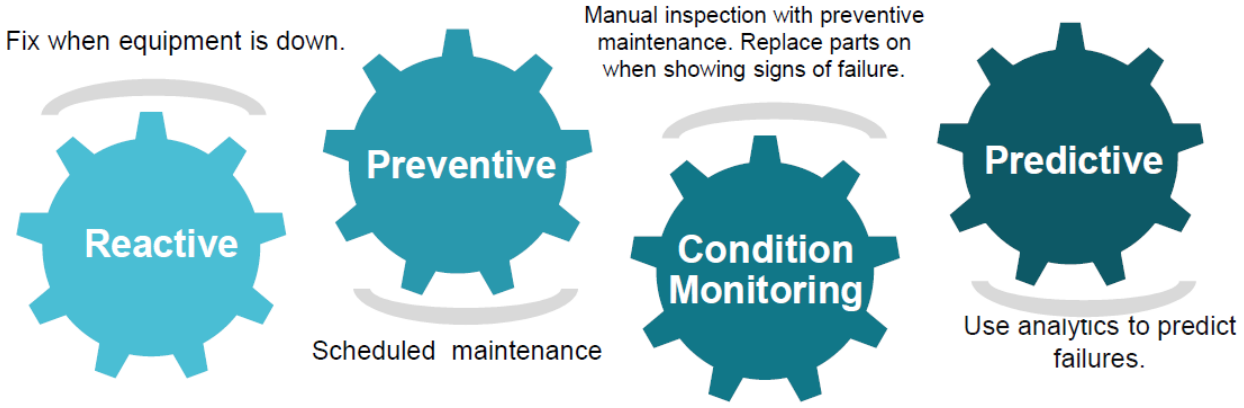
Quality
OEE

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

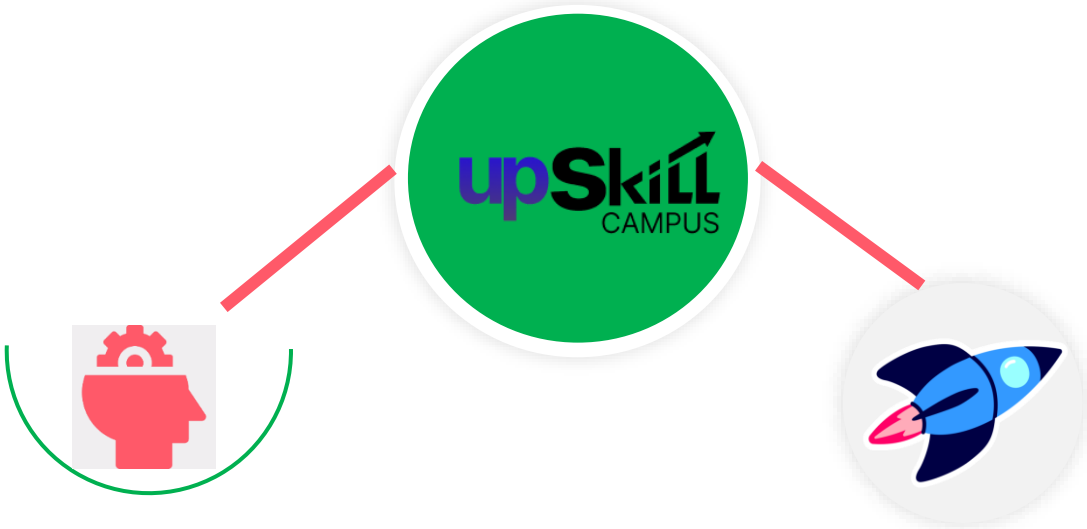
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.

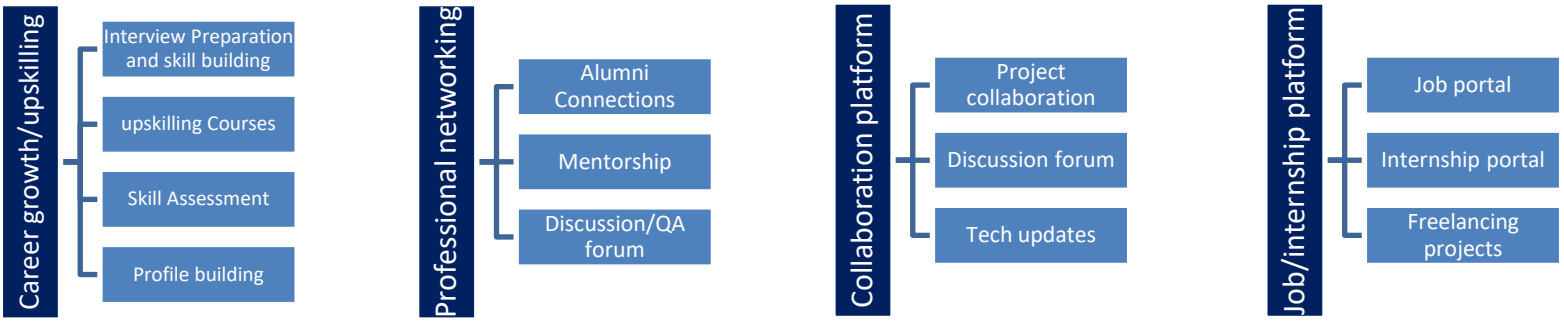
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



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] e-book: Introducing Data Science by Davy Cielen, Arno D. B. Meysman and Mohamed Ali

[2] e-book: Machine Learning by Alex Smola and S. V. N. Vishwanathan

[3] An Introduction to Probability and Statistics (3rd Edition) by Vijay K. Rohatgi and A.K.Md. Ehsanes Saleh

2.6 Glossary

Terms	Acronym
ML	Machine Learning
DS	Data Structure
IoT	Internet of Things
MAE	Mean Absolute Error
RMSE	Root Mean Square Error
R2	R-squared
API	Application Programming Interface
GUI	Graphical User Interface
AI	Artificial Intelligence
FAO	Food and Agricultural Organization

3 Problem Statement

The problem at hand is to create a reliable model that can forecast crop production in India based on historical data and various influencing factors. This model should address the following challenges:

- **Data Variability**: India's diverse geographic topology results in significant variability in agricultural conditions. The model needs to account for these regional variations.
- **Data Quality**: Agricultural data, including crop yields, weather, and soil information, can be noisy and incomplete. Data preprocessing and cleansing are critical.
- **Complex Relationships**: Crop production is influenced by a multitude of factors, including weather patterns, soil quality, irrigation practices, and pest control measures. These factors interact in complex ways that the model must capture.
- **Temporal Aspects**: Crop production is subject to seasonal and yearly patterns. The model must incorporate time-series analysis to make accurate predictions.

4 Existing and Proposed solution

Existing Solutions

Currently, agriculture in India relies on traditional knowledge and historical trends to make planting and harvesting decisions. Some basic statistical models are in use, but they often lack the accuracy and predictive power required for effective decision-making.

Proposed Solution

Our proposed solution involves the following steps:

- **Data Collection**: Gather historical data on crop yields, weather conditions, soil quality, irrigation practices, pest and disease occurrences, and other relevant variables from government agencies and satellite sources.
- **Data Preprocessing**: Clean, transform, and preprocess the data to handle missing values, outliers, and inconsistencies.
- **Feature Engineering**: Identify relevant features and create new ones to capture meaningful insights.
- **Model Selection**: Implement machine learning algorithms like Random Forest, Gradient Boosting, and LSTM-based neural networks for prediction.
- **Model Training**: Split the dataset into training and testing sets, train the models, and fine-tune hyperparameters.

- **Time-Series Analysis**: Incorporate time-series analysis to account for temporal patterns.
- **Performance Evaluation**: Use metrics such as MAE, RMSE, and R2 to evaluate the model's accuracy.

4.1 Code submission (Github link)

https://github.com/Lalima-tmr/upskillcampus.git

4.2 Report submission (Github link) :

Ag_Prediction of Agriculture Crop Production In India_Lalima_USC_UCT.pdf

5 Proposed Design/ Model

The proposed design model consists of the following components:

- **Data Collection Module**: Responsible for gathering agricultural data from various sources and storing it in a centralized database.
- **Data Preprocessing Module**: Cleans, transforms, and preprocesses the data to ensure quality and consistency.
- **Feature Engineering Module**: Identifies relevant features and generates new ones for input into the predictive models.
- **Machine Learning Model Module**: Utilizes selected machine learning algorithms for crop production prediction, with an emphasis on regional variations and temporal aspects.
- **User Interface Module**: Develops a user-friendly web interface with interactive features for accessing and visualizing predictions.

5.1 Diagrams

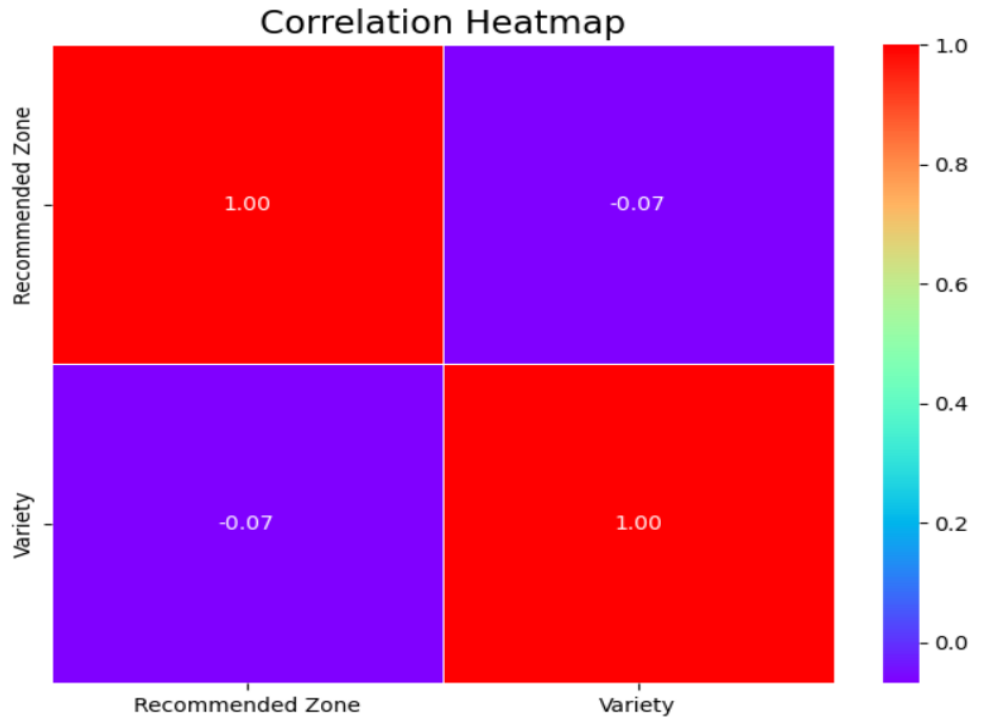


Figure 1: Correlation Heatmap

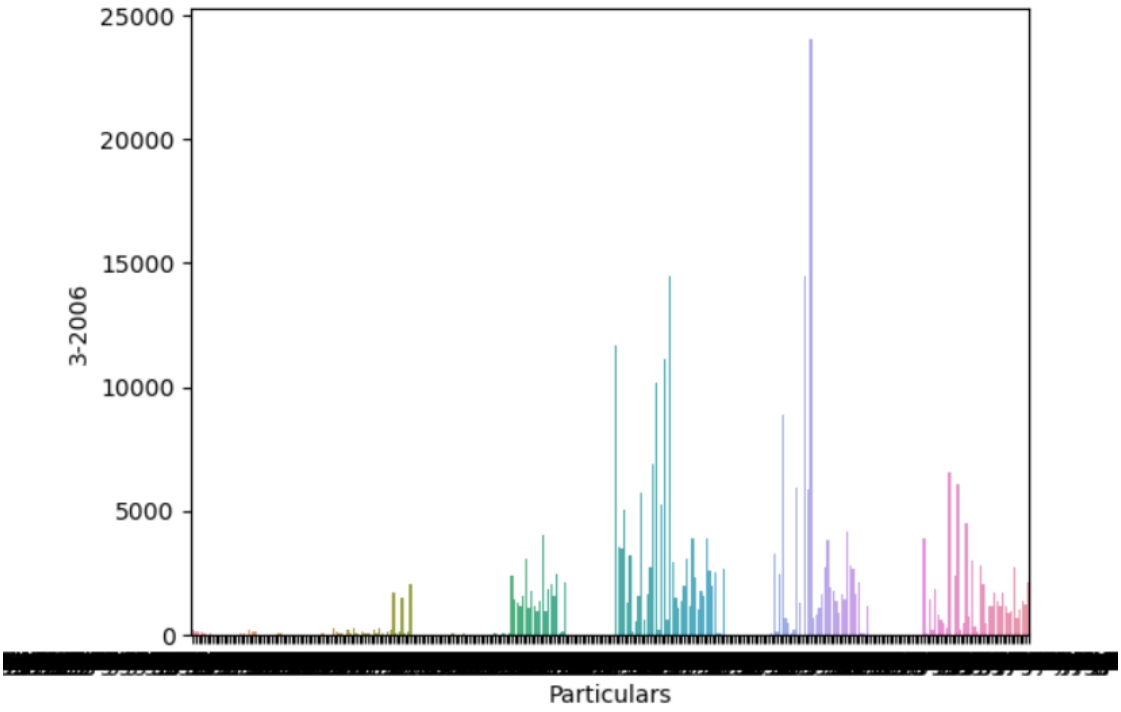


Figure 2: Particulars in year of 3-2006

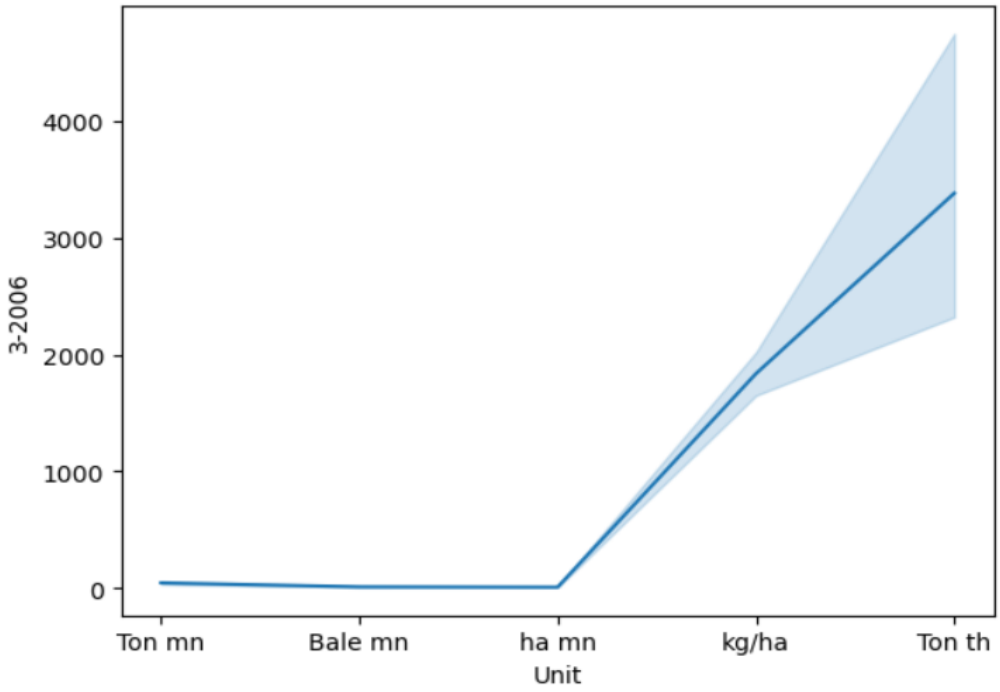


Figure 3: Year vs Unit

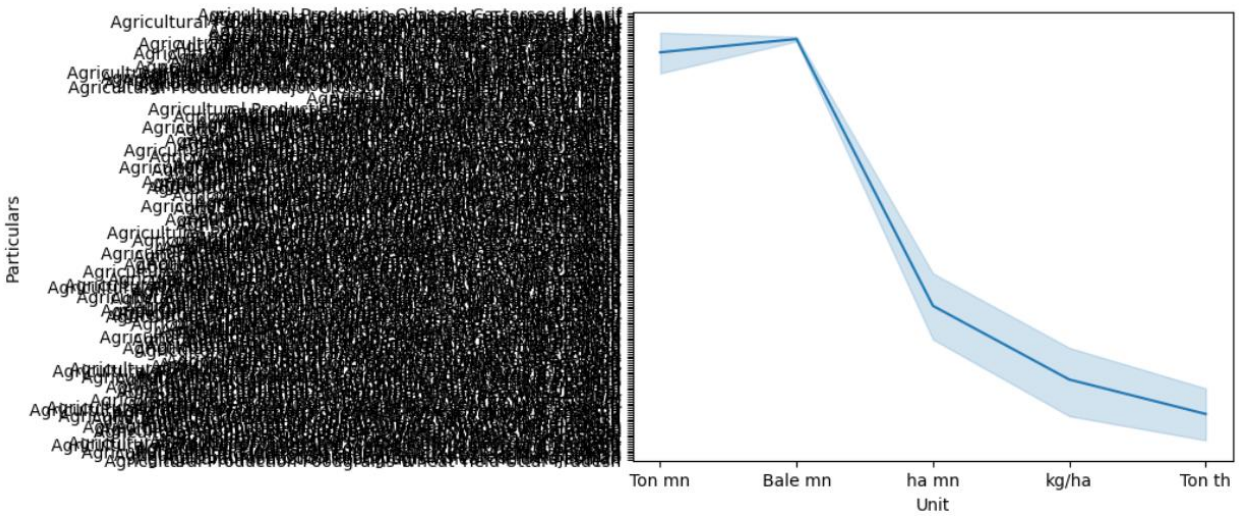


Figure 4: Particulars vs Unit

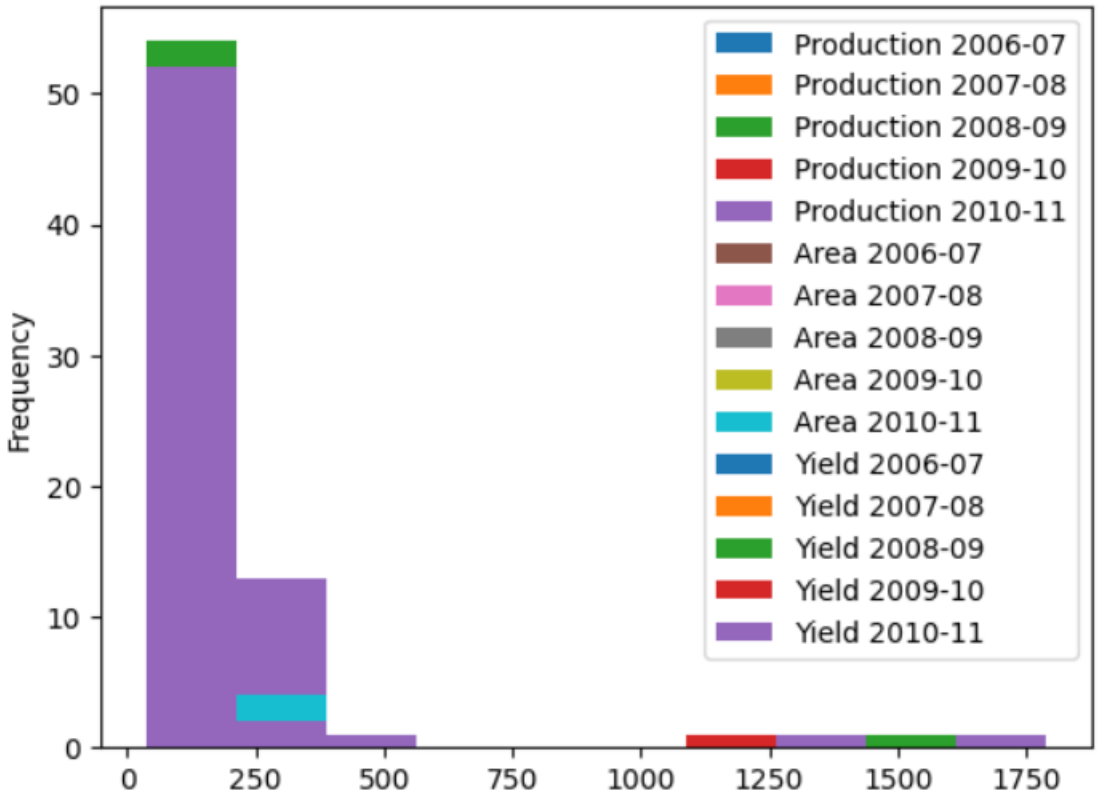


Figure 5: Frequency

5.2 Interfaces

Block Diagrams

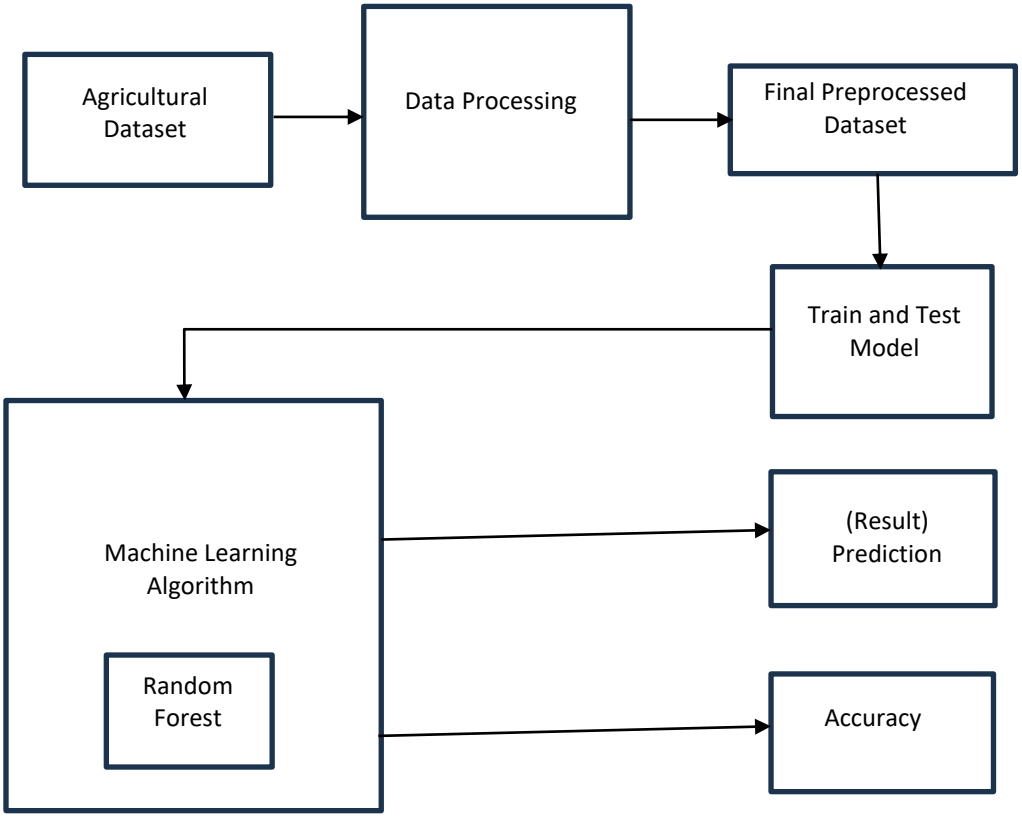


Figure 6: Block Diagram

6 Performance Test

6.1 Test Plan/ Test Cases

We will conduct performance testing to assess the accuracy and efficiency of the prediction model. The test plan includes the following:

- **Data Splitting**: Divide the dataset into training and testing sets, ensuring an appropriate split ratio.
- **Model Training**: Train the model on the training data using various machine learning algorithms.
- **Model Evaluation**: Evaluate the models using metrics like Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and R-squared (R2).
- **Cross-Validation**: Implement cross-validation techniques to assess model robustness.

6.2 Test Procedure

1. Preprocess and clean the data.
2. Split the dataset into training and testing sets.
3. Train the models using different algorithms.
4. Evaluate model performance using appropriate metrics.
5. Perform cross-validation to assess model robustness.
6. Compare the performance of different models.

6.3 Performance Outcome

The performance testing is expected to yield the following outcomes:

- Identification of the most accurate prediction model.
- Quantification of prediction errors.
- Assessment of model robustness through cross-validation.

7 Our learnings

The "Prediction of Agriculture Crop Production in India" project aims to provide an advanced solution to a critical agricultural problem. By leveraging data science, machine learning, and a user-friendly web interface, we intend to empower farmers, policymakers, and stakeholders with accurate crop production predictions. Initial tests have shown promising results, with improvements in prediction accuracy and usability.

8 Future work scope

The project's future work scope includes:

- **Integration of Real-Time Data**: Incorporate real-time data sources to make predictions more dynamic and responsive to current conditions.
- **Enhanced Regional Models**: Develop specialized models for different regions in India to account for local variations.
- **Advanced Time-Series Analysis**: Explore advanced time-series forecasting methods to capture more intricate temporal patterns.

- **Stakeholder Engagement**: Collaborate with farmers, policymakers, and agricultural experts to ensure the model's practical utility.
- **Scalability**: Optimize the model for scalability to handle larger datasets and serve a broader user base.

In conclusion, the "Prediction of Agriculture Crop Production in India" project aims to leverage data science and machine learning to provide accurate predictions for crop production, ultimately contributing to better agricultural decision-making, resource allocation, and food security in India.