Industrial Internship Report on

Crop and Weed detection

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 (Crop and Weed detection) 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

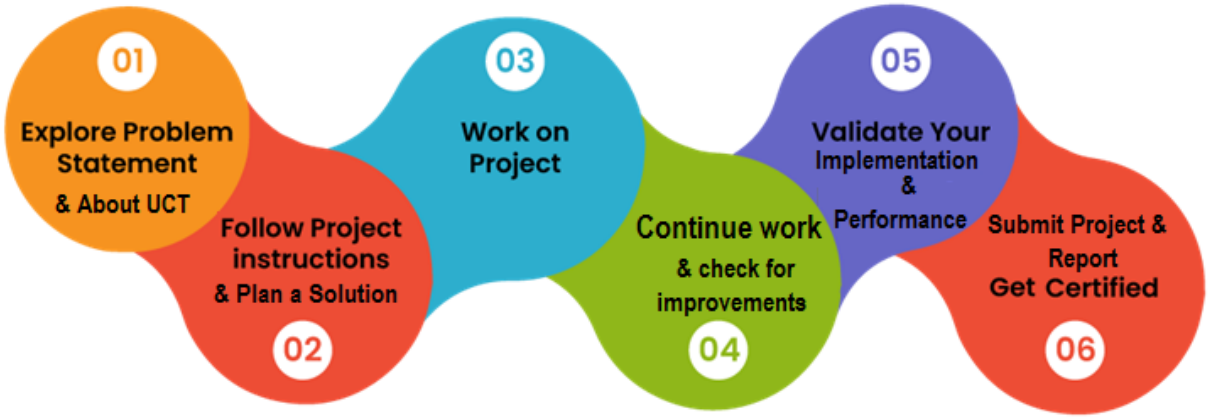
During the span of 6 week, we started the first week by exploring all the problem statements and finalizing the project and knowing the uniconverge technologies and later on started implementing the project on the regular basis like collecting the dataset and preprocess it and then creating and training the model and after this part evaluating the model and finally testing the results.

Relevant internships are a crucial step in your career development journey. They provide opportunities for learning, skill development, and gaining a deeper understanding of your chosen field and exposure of working on the industry level project and the process cycle that is to be followed.

The problem statement, "Crop and Weed Detection Using AI and ML," aims to harness advanced technologies to revolutionize crop detection and weed control in agriculture. By creating precise, effective, and user-friendly AI and ML solutions, we seek to empower farmers to optimize crop yields, minimize resource wastage.

The opportunity provided by USC/UCT has been a significant milestone in my academic and professional journey. It has allowed me to access world-class resources I am grateful for the opportunity to be a part of the USC & UCT community.

How Program was planned



During this project, I had the opportunity to work on a real-world problem, learn deeply into the world of neural networks. This involved designing, training, and most importantly testing the project with respect to real world implementation. Contrasting this experience with academic projects.

I extend my heartfelt thanks to Mr. Kaushlendra Singh Sisodia, Mr. Nitin Tyagi, and Mr. Apurv for their significant contributions, both direct and indirect, to my knowledge and skill development during the smooth conduct of my internship for six weeks.

To my juniors and peers, I want to emphasize the significance of industrial training, as it introduces you to a new world. Maintain a commitment to ongoing learning and exploration, without fear of asking questions or engaging in collaboration. These steps are the paths to your learning, innovation, and the creation of something of great worth.

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.

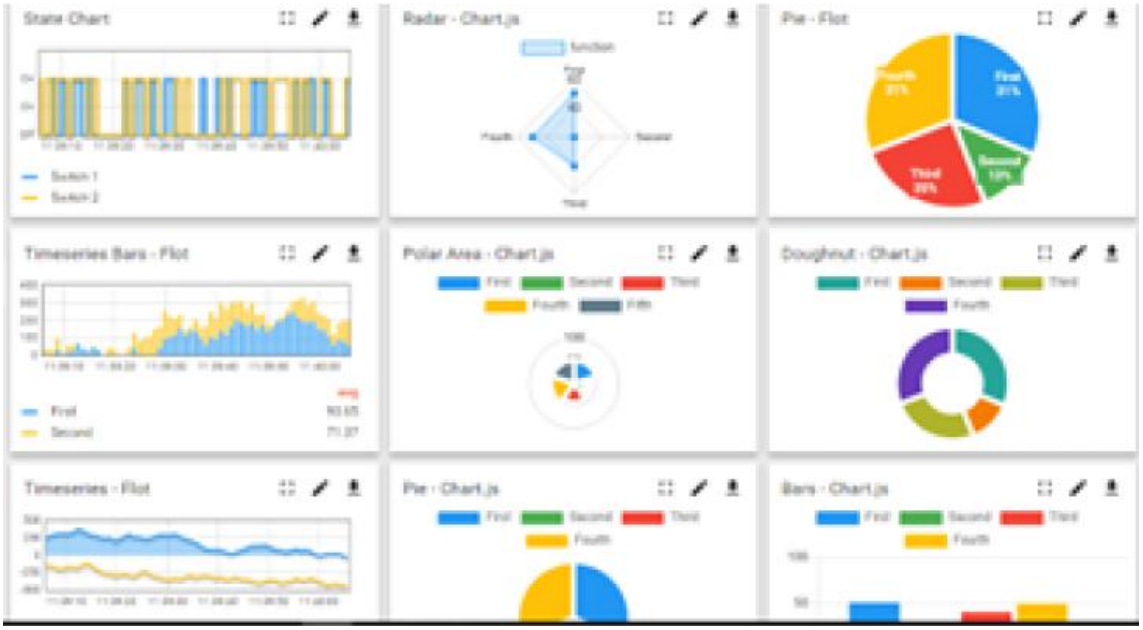
i. UCT IoT Platform (UCT Insight)

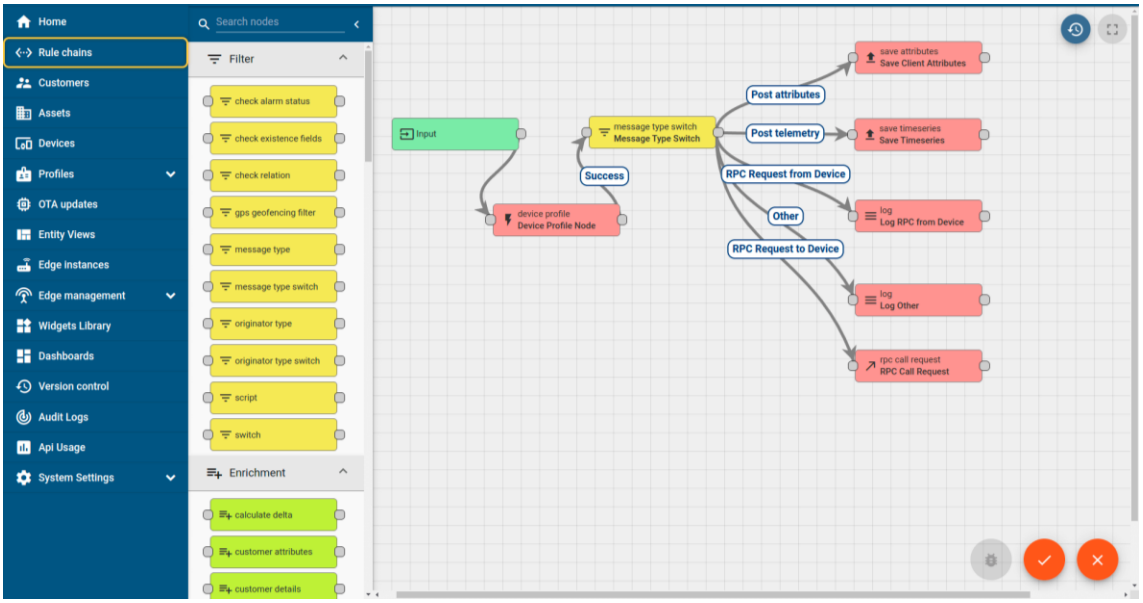
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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
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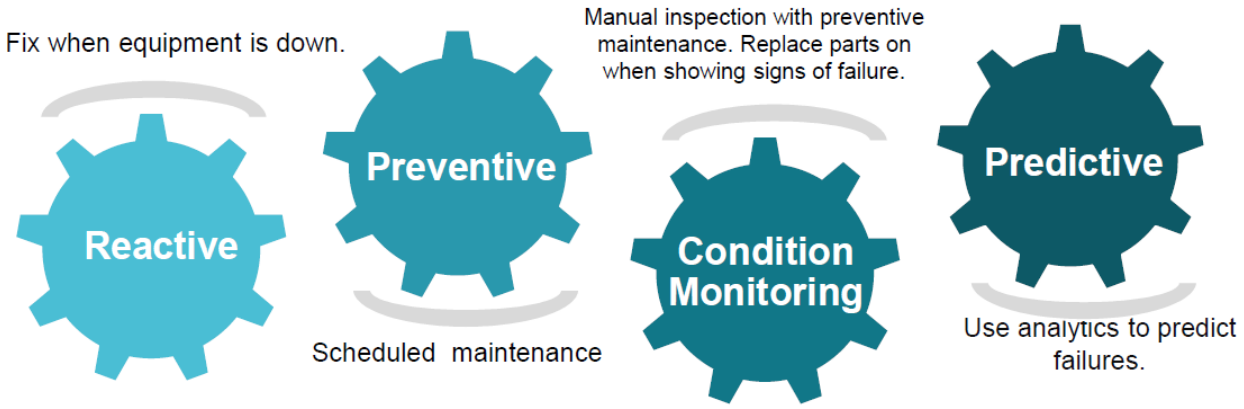
iii. LoRaWAN based Solution

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

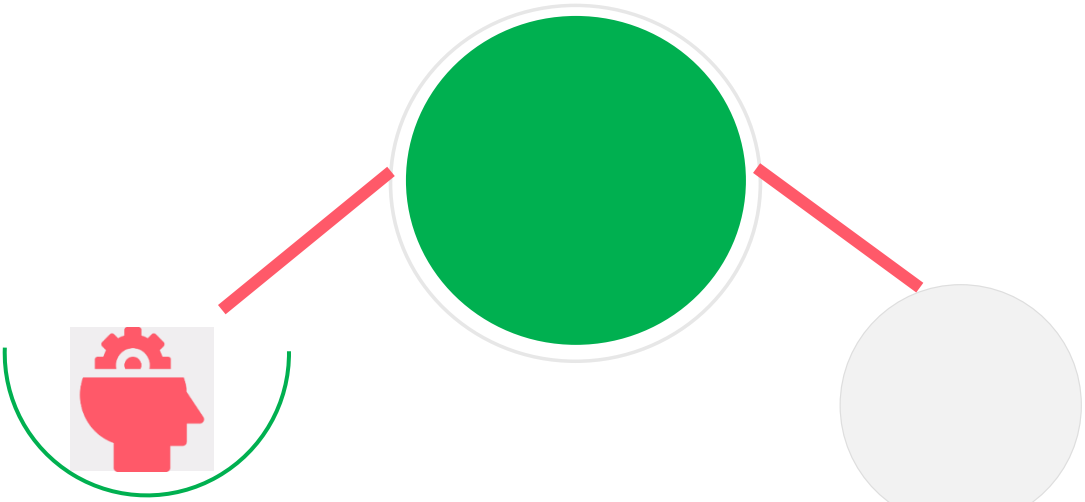
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.

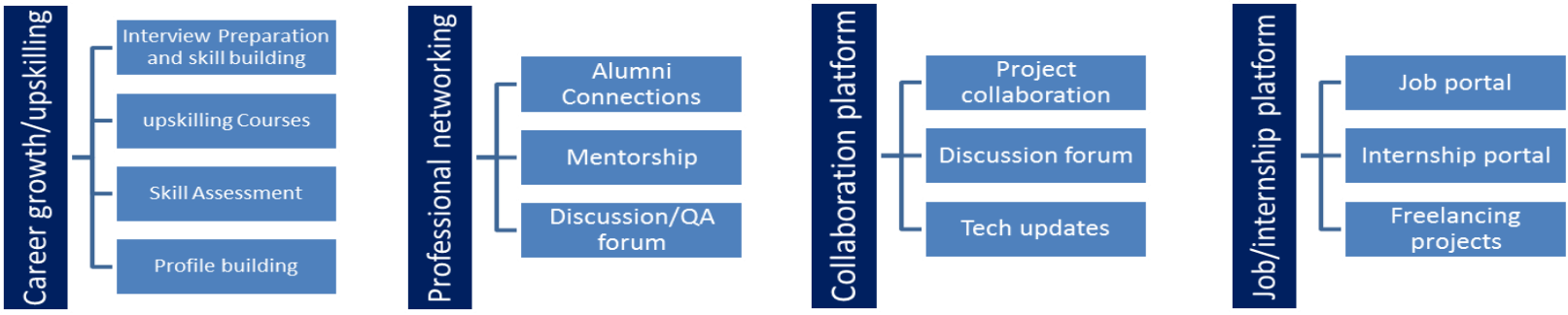
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



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/datasets/ravirajsinh45/crop-and-weed-detection-data-with-bounding-boxes

[2] https://www.youtube.com/watch?v=jztwpsIzEGc

2.6 Glossary

Terms	Acronym
AI	Artificial Intelligence
ML	Machine Learning
CNN	Convolutional Neural Network
API	Application Programming Interface (a set of rules for software interaction)
MIPS	Millions of Instructions Per Second (a measure of processing speed)

3 Problem Statement

Crop and Weed Detection Using AI and ML

- The problem statement, "Crop and Weed Detection Using AI and ML," aims to harness advanced technologies to revolutionize crop detection and weed control in agriculture.
- By creating precise, effective, and user-friendly AI and ML solutions, we seek to empower farmers to optimize crop yields, minimize resource wastage, and play a pivotal role in bolstering global food security.
- Furthermore, these solutions will serve as a shield, protecting plants from the potentially harmful effects of pesticides while nurturing the growth of healthy plants and fruits.

4 Existing and Proposed solution

Existing solutions provided by others and their limitations?

- Some existing AI/ML solutions use image recognition algorithms to identify crops and weeds in images captured by drones or cameras. These algorithms can distinguish between different plant types based on visual characteristics.
- AI/ML models can create weed distribution maps using data from satellite imagery. This helps farmers identify areas of high weed density.

The proposed solution

Create and train advanced machine learning models, like convolutional neural networks (CNNs), designed specifically for the purpose of recognizing crops and weeds. These models excel in accurately identifying and categorizing it. Moreover, they can be adapted to handle video frames, expanding their capabilities beyond static images and target their weed control efforts more effectively.

Value addition planned

One of the paramount benefits of these solutions is their ability to protect crops from the potentially detrimental effects of pesticides. Through precise detection mechanisms, farmers can employ targeted interventions, reducing the need for excessive pesticide application and ensuring healthier, pesticide-free produce. Additionally, these AI and ML technologies foster the growth of robust, thriving plants and fruits, resulting in higher-quality agricultural products.

4.1 Code submission (Github link)

https://github.com/KevalPadsala/upskillcampus/blob/main/Crop_and_Weed_Detection_final.ipynb

(It is a google colaboratory file)

4.2 Report submission (Github link):

https://github.com/KevalPadsala/upskillcampus/blob/main/cropandweeddetection_kevalpadsala_USC_UCT.pdf

5 Proposed Design/ Model

- **Problem Definition**: Clearly define the problem and gather requirements.
- **Data preprocessing:** Collect, clean, exploring the data and apply data augmentation to increase the dataset.
- **Data splitting:** Splitting the dataset in the appropriate proportion that is 80 20 respectively which is universally preferred ratio.
- **Model Selection:** Choose an appropriate model or algorithm we have used convolutional neural network (CNN) as it is the best model for image classification.
- **Model Training:** Train and optimize the model.
- **Model Evaluation:** Evaluate and fine-tune the model.
- **Predict:** Finally predicting the output

6 Performance Test

During the testing we noticed that in low resolution videos also the model was able to predict so it will take care of challenging environmental conditions in agriculture such as fog, dust, and vibrations.

For applications demanding real-time or near-real-time responsiveness, efficient processing is essential for making rapid decisions. Although the results didn't achieve pinpoint accuracy, they exceeded the baseline expectations, rendering them highly satisfactory and within acceptable limits.

Cost constraints refer to how affordable it is to implement AI/ML solutions in agriculture, including the costs for hardware, software, and maintenance. Unfortunately, we couldn't determine an exact cost estimate.

6.1 Test Plan/ Test Cases

- Test Case 1: Input an image containing a single crop. Verify that the system correctly identifies the crop and provides accurate location information.
- Test Case 2: Input an image with no crop. Ensure the system reports no crop detection and weed detected.
- Test Case 3: Introduce low quality videos/images and verify system robustness.
- Test Case 4: Verify the system's responsiveness when presented with a continuous stream of data.

6.2 Test Procedure

- Test Objective: To verify that the system correctly identifies a crop and weed in an image
- Test Data: Input a high/low-resolution image or video containing a weed or crop.
- Procedure: Submit the image to the system for analysis. Record the system's detection results.
- Expected Outcome: The system should accurately identify whether it is a crop or weed.

6.3 Performance Outcome

The machine learning model shows remarkable proficiency when tasked with analysing both high-resolution and low-resolution images. In these scenarios, it demonstrates a high level of accuracy and reliability, effectively identifying and categorizing objects of interest within the images. However, a noticeable decline in performance becomes apparent when the same model is applied to video data as opposed to static images.

7 My learnings

During this project, I had the opportunity to work on a real-world problem, learn deeply into the world of neural networks. This involved designing, training, and most importantly testing the project with respect to real world implementation. Contrasting this experience with academic projects, I discovered that working on industry-level projects is a significantly different experience. It entailed identifying and addressing various constraints, which was a unique experience. Overall, this project provided an excellent learning opportunity, allowing me to gain practical experience in handling real-world projects and go through the unique challenges they present.

8 Future work scope

I would have liked to incorporate live streaming detection into the project, but due to time constraints, it wasn't possible. However, I plan to explore this aspect in the future.

Additionally, I want to highlight that we conducted model accuracy testing through only one or two methods, while there are multiple testing methods that should be explored for a comprehensive evaluation.