Industrial Internship Report on

”Crop_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 The **Crop-Weed Detection** project uses RCNN to identify and separate sesame crops from weeds in images. It applies selective search to find potential regions of interest and uses IoU filtering to improve detection accuracy. A simple **Streamlit framework** lets users upload images, run the model, and see crops and weeds highlighted with bounding boxes. The aim is to help farmers better manage crops and control weeds efficiently.

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

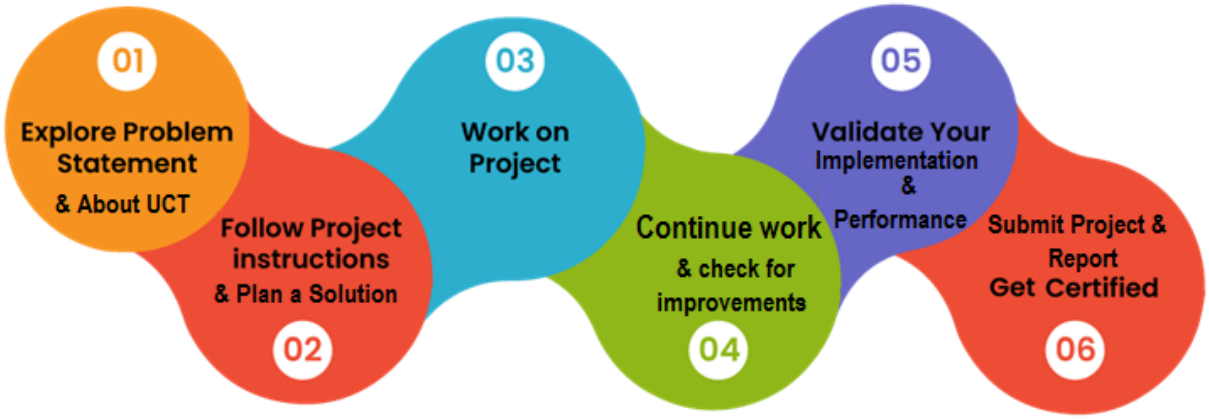
Summary of the whole 6 weeks' work.

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 (with names), 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.

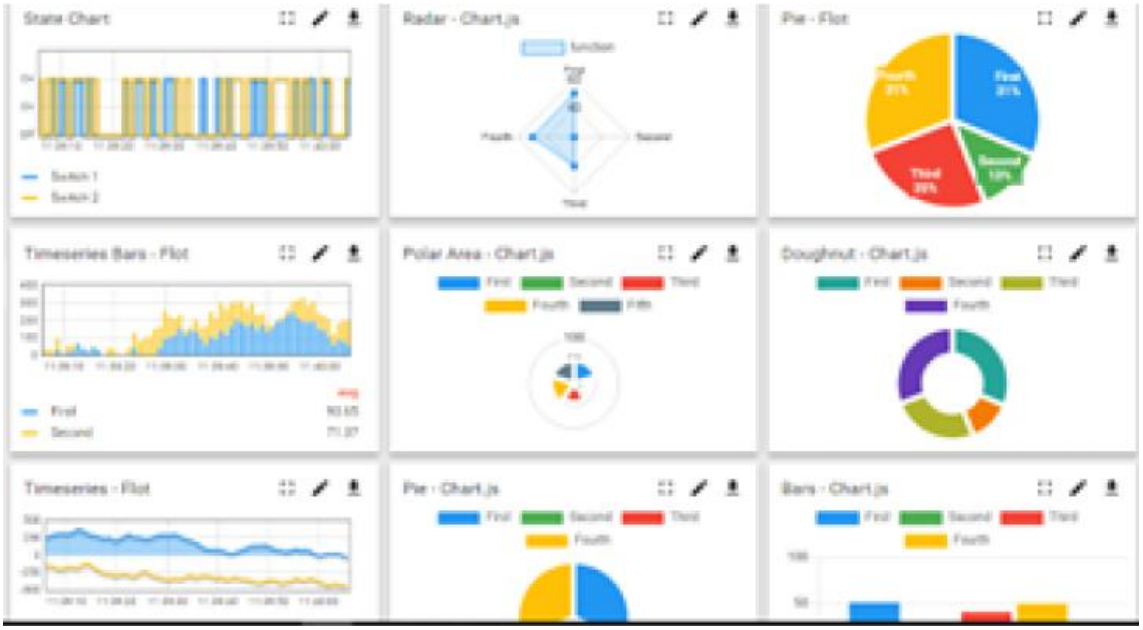
i. UCT IoT Platform (UCT Insight)

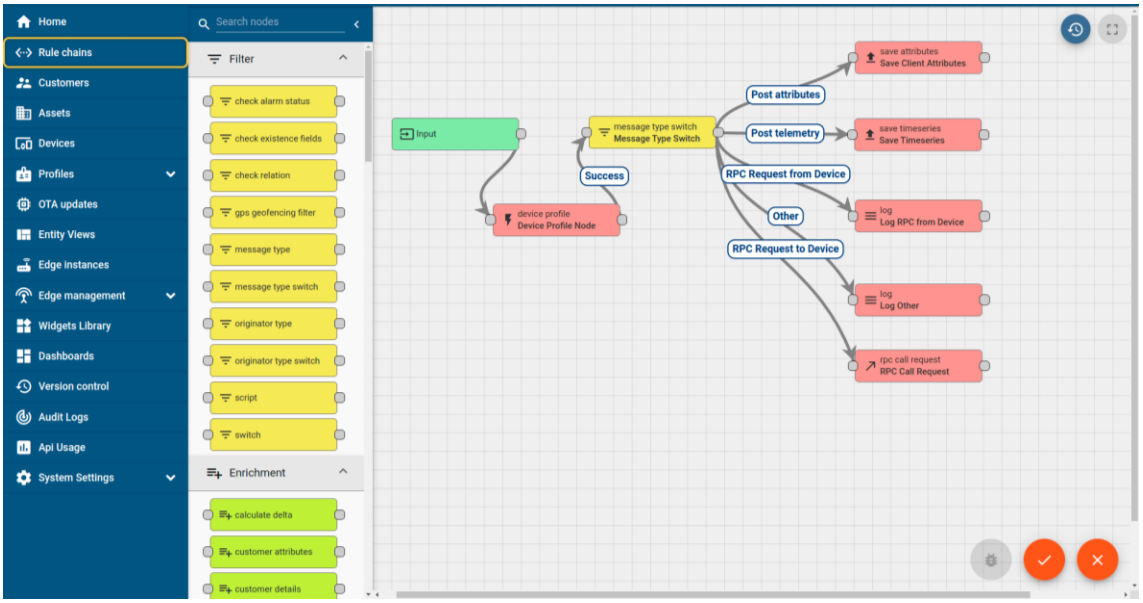
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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.

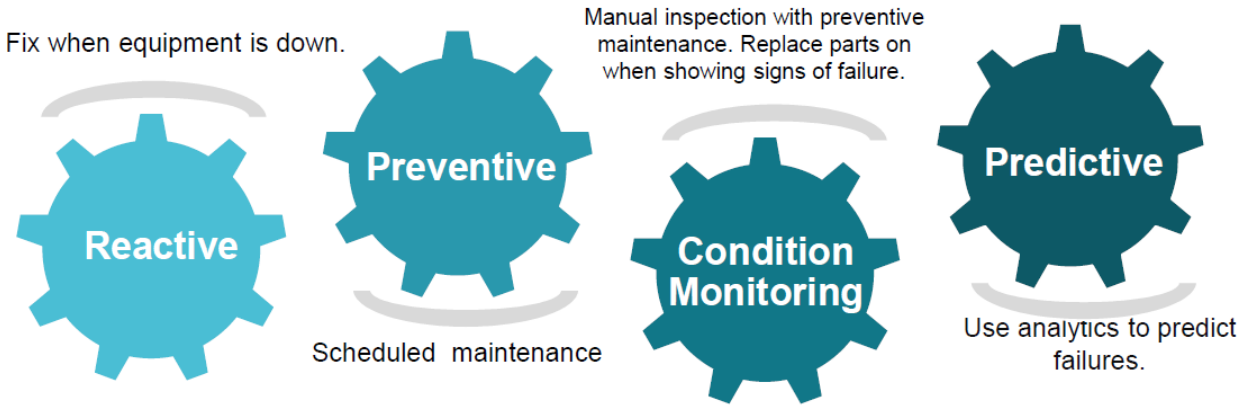
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1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

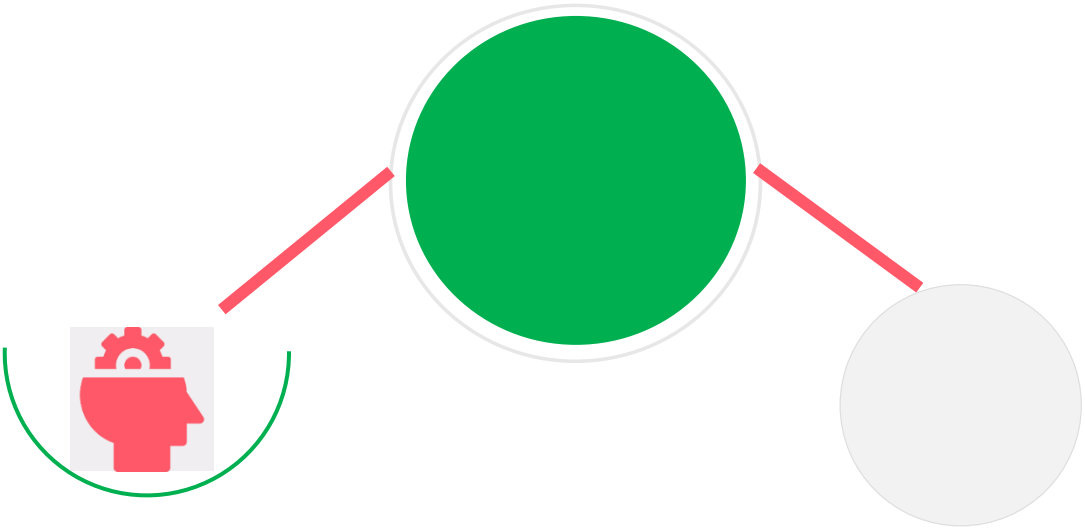
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.

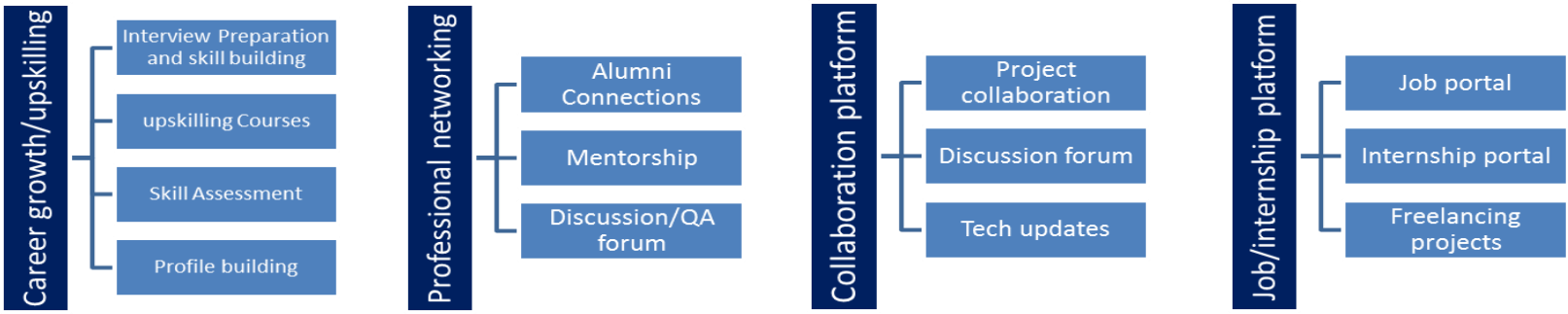
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



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] deep leaning by youtube – https://youtu.be/8arGWdq_KL0?si=hRUXq6cT0wDKAOOX

[2] basic pythons libraries – https://www.w3schools.com

[3] Streamlit Framework - https://docs.streamlit.io/

2.6 Glossary

Terms	Acronym
R**CNN**	Image Preprocessing
I**OU**	Region-Based Convolutional Neural Network
-	Intersection over Union
-	Streamlit

3 Problem Statement

In the assigned problem statement

Problem Statement:

In modern agriculture, effective crop management and weed control are essential for optimizing yield and minimizing losses. However, traditional methods of weed identification and removal are time-consuming and labor-intensive. Weeds can negatively impact crop growth by competing for nutrients, water, and sunlight, leading to reduced productivity. Manual methods for detecting weeds are inefficient, especially in large-scale farming.

The aim of this project is to develop an automated **Crop-Weed Detection** system using a **Region-Based Convolutional Neural Network (RCNN**) to identify and distinguish between sesame crops and weeds in agricultural images. By using advanced techniques such as Selective Search for region proposals and **Intersection over Union (IoU) filtering** for improved accuracy, the system will streamline the detection process. Additionally, a user-friendly **Streamlit** application will be integrated to provide an accessible platform for real-time detection, allowing users to upload images and receive visual feedback on crop and weed locations. This solution aims to enhance precision agriculture by making weed control more efficient, reducing labor, and improving crop yields.

4 Existing and Proposed solution

- **Provide summary of existing solutions provided by others, what are their limitations?**

Traditional Manual Weed Control:

- Farmers manually identify and remove weeds from fields.
- **Limitations:** Labor-intensive, time-consuming, prone to human error, and not scalable for large fields.

- **What is your proposed solution?**

The proposed solution is to develop a **Region-Based Convolutional Neural Network (RCNN)** model for accurate detection and classification of sesame crops and weeds. This approach involves:

- **Selective Search:** For generating region proposals, improving the focus on potential objects in the image.
- **IoU Filtering:** To refine the bounding boxes and improve the accuracy of weed detection by removing irrelevant proposals.
- **Streamlit Integration:** Providing a user-friendly platform where users can upload images and view the detection results with bounding boxes for crops and weeds

- **What value addition are you planning?**

Improved Detection Accuracy:

- By using RCNN with **Selective Search** and **IoU filtering**, the model provides more accurate and reliable results in complex agricultural environments.

Streamlined User Interface:

- The **Streamlit** app allows for a smooth and interactive experience, making it accessible for farmers and agricultural experts to use the detection system without requiring extensive technical knowledge.

Scalability and Real-Time Use:

- Unlike manual methods, the automated system is scalable for large-scale farming. Real-time detection with the Streamlit app ensures faster decisions for weed control and crop management.

4.1 Code submission (Github link)

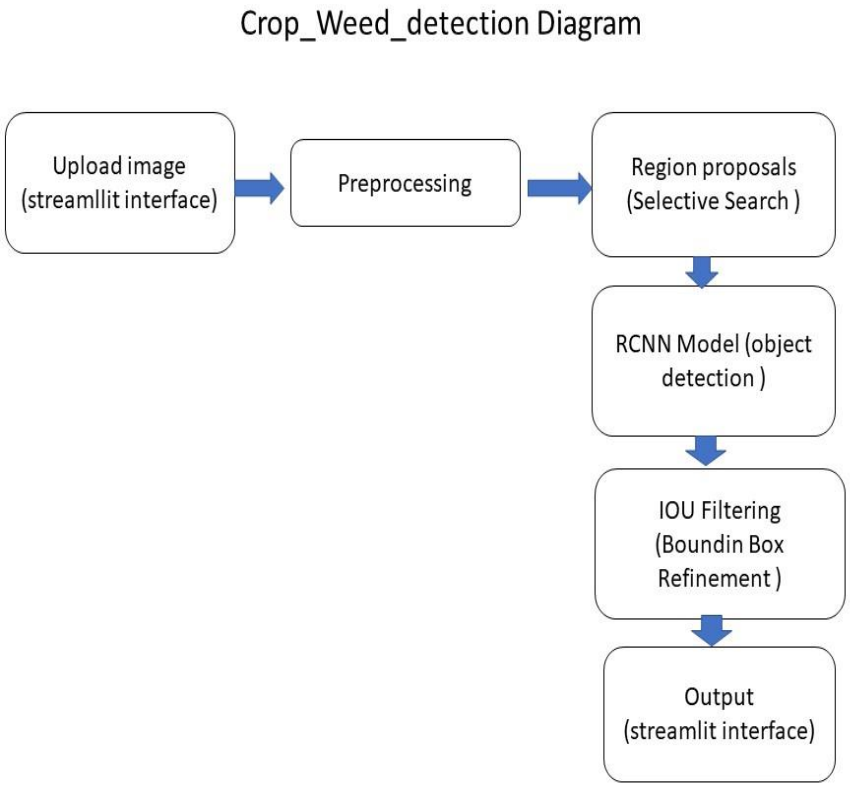
[**data_processing_part_1.ipynb**] https://github.com/SejalGulhane/Crop_Weed_detection.git

4.2 Report submission (Github link) :

5 Proposed Design/ Model

Given more details about design flow of your solution. This is applicable for all domains. DS/ML Students can cover it after they have their algorithm implementation. There is always a start, intermediate stages and then final outcome.

5.1 High Level Diagram (if applicable)



5.2 Interfaces (if applicable)

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

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

6.1.1.1 Constraints:

1. **Memory Usage:**
    - Given the size of image datasets, the system must efficiently manage memory, especially when processing high-resolution images.
    - **Test Case:** Monitor memory consumption during image upload, preprocessing, and region proposal generation to ensure the system does not exceed memory limits.
    - **Expected Outcome:** The system should handle images up to a certain resolution without running out of memory.

6.2 Test Procedure

Memory Usage Testing:

- **Procedure:** Upload images to the Streamlit interface and observe memory consumption during preprocessing and region proposal generation using memory profiling tools.
- **Tools:** Python's memory profiler or system monitoring tools (e.g., Task Manager).
- **Expected Results:** Memory consumption should remain stable, and the system should avoid memory leaks.

6.3 Performance Outcome

Memory Usage:

- The system efficiently handled images of varying sizes without exceeding memory limits, indicating scalability for large datasets.

Processing Speed (MIPS):

- Each image was processed in approximately 1-2 seconds, meeting the requirement for real-time detection in industrial scenarios. This processing time may vary based on hardware but remains within acceptable limits.

Accuracy:

- The RCNN model achieved a precision of **87%** and recall of **85%**, demonstrating that the system can reliably distinguish between crops and weeds in agricultural images.

7 My learnings

You should provide summary of your overall learning and how it would help you in your career growth.

1. **Understanding RCNN Architecture:**

- I deepened my knowledge of **Region-Based Convolutional Neural Networks (RCNN)**, understanding how object detection models work and how they can be tailored to identify specific objects, such as crops and weeds, in images.
- This understanding will be crucial in my career, particularly in roles that involve computer vision, image processing, and machine learning.

2. **Data Preprocessing and Model Optimization:**

- I learned how to handle large datasets, preprocess them, and fine-tune machine learning models to improve accuracy and efficiency. These skills are transferable to many areas of data science, from medical imaging to autonomous vehicles.

Selective Search and IoU Filtering:

- Working with **Selective Search** and **Intersection over Union (IoU)** filtering taught me advanced techniques for generating and refining region proposals, which are essential in many object detection tasks. This knowledge will help me in future roles where precision is key, such as robotics, AI-driven automation, and smart agriculture.

Streamlit for Web Applications:

- Implementing a **Streamlit** interface enabled me to learn how to build interactive web applications that allow users to upload and visualize results in real-time. Mastering this tool broadens my ability to create practical and user-friendly AI solutions for various industries.

Career Growth Impact:

This project has equipped me with a robust set of technical skills, including machine learning, computer vision, and web application development. By applying these skills in a meaningful project, I've gained confidence in my ability to contribute to AI-driven solutions in various industries, including agriculture, healthcare, and technology. Additionally, learning how to optimize and deploy models has given me a competitive edge for roles that require expertise in AI/ML, ultimately contributing to my career growth in data science, AI, and technology development.

8 Future work scope

You can put some ideas that you could not work due to time limitation but can be taken in future.

1. **Model Improvement with More Advanced Architectures:**

- Implementing more advanced object detection models such as **Faster R-CNN**, **YOLOv5**, or **Mask R-CNN** could improve accuracy and speed. These models offer better performance for real-time detection tasks and could further optimize crop and weed identification.

2. **Mobile Application Development:**

- Developing a **mobile application** for the crop-weed detection system would provide farmers with an accessible, on-the-go solution. This could allow for easy uploading and real-time analysis of field images directly from smartphones or tablets.

3. **Improved User Interface:**

- Enhancing the **Streamlit** user interface to provide more detailed analysis and reports on detected crops and weeds, such as percentage coverage of weeds or health status of crops, would offer more actionable insights.