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**” is being developed to detect crops and weed from various plants so that spraying of pesticides is done only on weed and not on crops, which will reduce the mixing problem with crops and also reduce the waste of pesticides. 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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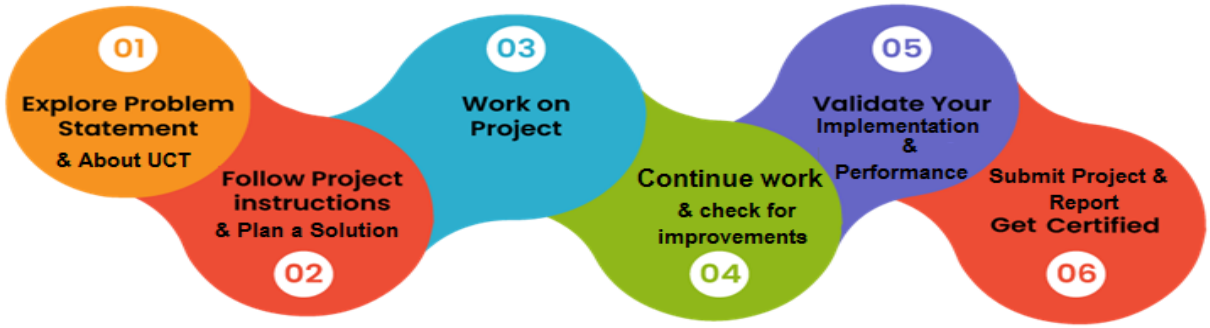
1 Preface

Thank you UCT for giving this opportunity.

Problem Statement: We are working with the government to transform various cities into a smart city. The vision is to convert it into a digital and intelligent city to improve the efficiency of services for the citizens. One of the problems faced by the government is traffic. You are a data scientist working to manage the traffic of the city better and to provide input on infrastructure planning for the future.

For the 6 weeks, we analyzed the problem statement. Understood the problem statement and the plan of the program and understood the existing solution. Along with my team member we worked on the project to obtain a proposed solution. Solved the problem statement and obtained crisp representation using Microsoft Power BI. In the last week we prepared the report and submitted the project.

How Program was planned



Overall it was a good experience, as we got to learn many things like how to analyze the data, data cleaning and data munching and how to represent the data.

I would like to take this opportunity and thank UCT for providing us with this opportunity. I would like to thank the online websites which we referred and my team member for giving the input and constantly working on the project along with me.

To my juniors I would like to suggest not to miss this opportunity and make proper use of it and not to miss any quiz.

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.

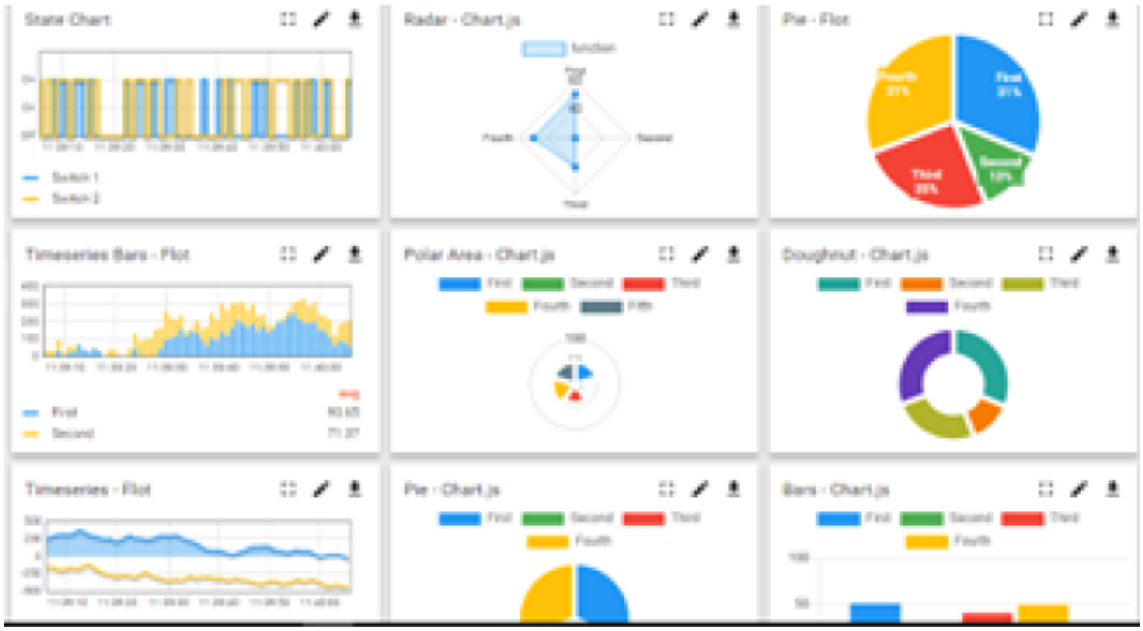
i. UCT IoT Platform (UCT Insight)

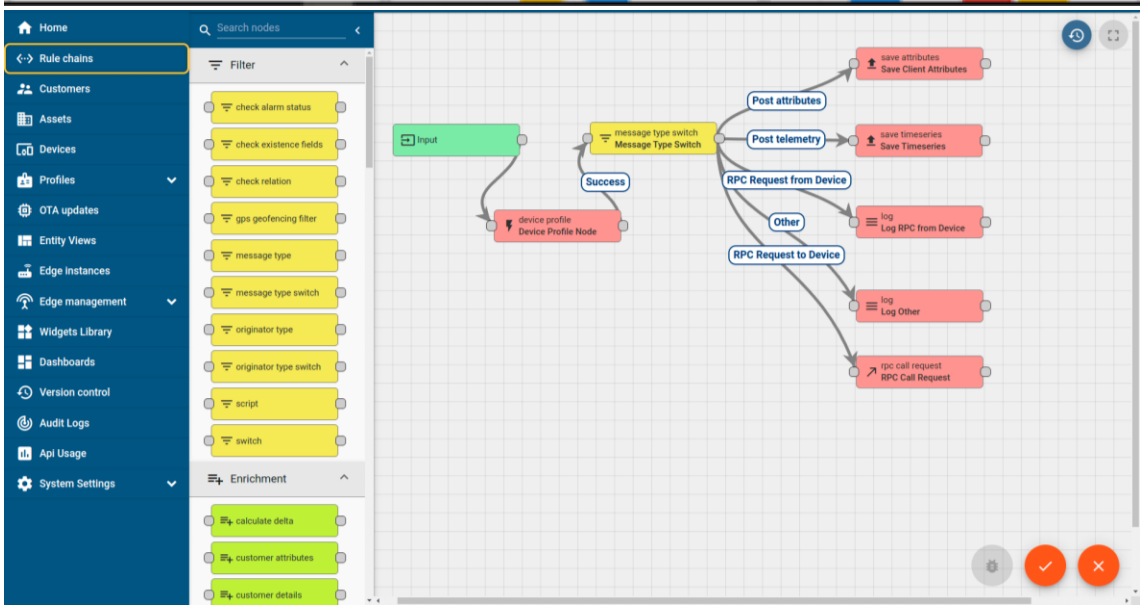
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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.

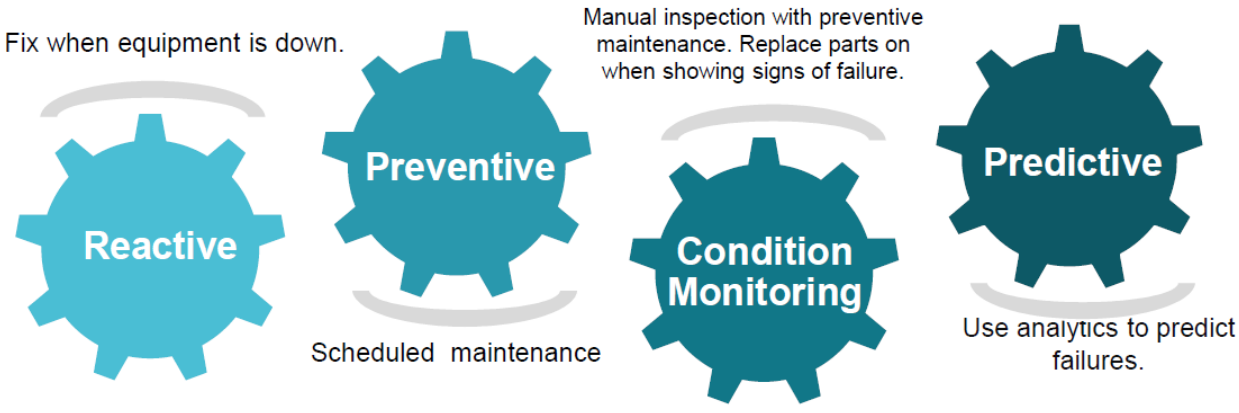
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1	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 technology and providing solution in Agritech, Smart cities, Industrial Monitoring, Smart Street Light, Smart Water/ Gas/ Electricity metering solutions etc.

iv. Predictive Maintenance

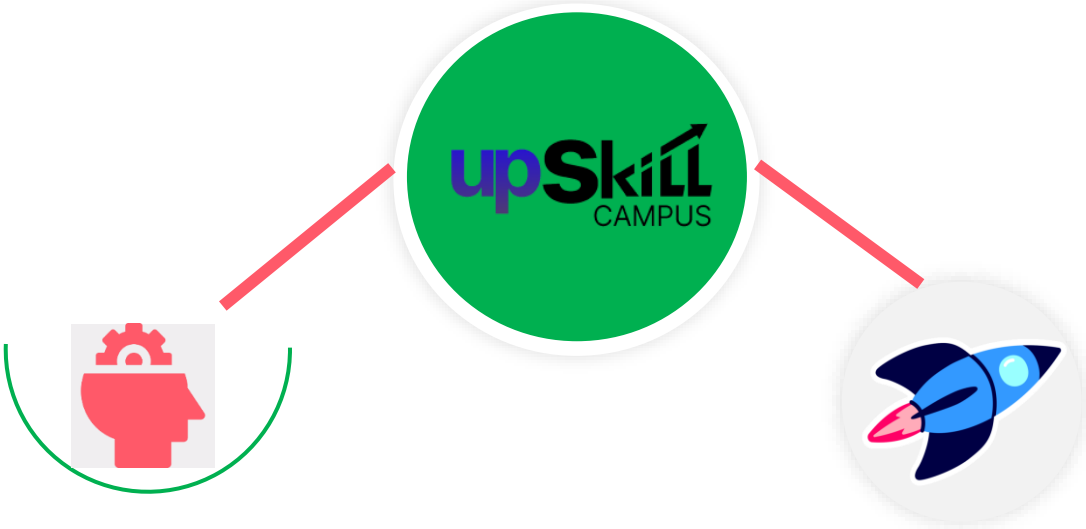
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.

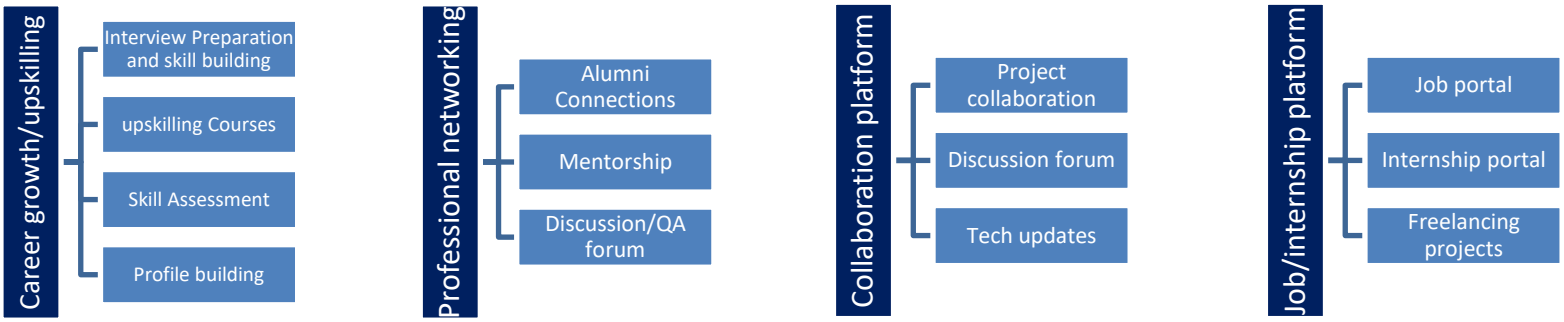
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way



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.mygreatlearning.com/blog/yolo-object-detection-using-opencv

[2] https://github.com/ravirajsinh45/Crop_and_weed_detection

[3] https://www.kaggle.com/datasets/ravirajsinh45/crop-and-weed-detection-data-with-bounding-boxes

2.6 Glossary

Terms	Acronym
Crop	a cultivated plant that is grown on a large scale commercially, especially a cereal, fruit, or vegetable.
Weed	any wild plant that grows in an unwanted place, especially in a garden or field where it prevents the cultivated plants from growing freely.

3 Problem Statement

Developing an automated system for crop and weed detection in agricultural fields using computer vision and machine learning techniques to optimize crop yield and reduce weed interference.

Description: Agriculture plays a crucial role in feeding the global population, and efficient crop management is essential to ensure food security. However, the presence of weeds in agricultural fields can significantly reduce crop yields and increase the cost of production. Traditional methods of weed detection and manual removal are time-consuming and labor-intensive.

To address this challenge, we aim to create an automated system that can:

1. Detect Crop and Weed Species: Develop a computer vision system capable of identifying various crop species and distinguishing them from weed species commonly found in agricultural fields.

2. Data Integration: Collect and integrate environmental data, including weather conditions and soil health, to provide a holistic view of the field's health and optimize crop management strategies.

3. User-Friendly Interface: Create a user-friendly interface or mobile application for farmers to access real-time information about their fields and make data-driven decisions.

4. Cost-Efficiency: Ensure that the system is cost-effective for small-scale farmers, making it accessible to a wide range of agricultural operations.

By developing an accurate and efficient crop and weed detection system, we aim to empower farmers with the tools and information they need to increase crop yields, reduce the use of pesticides, and improve overall agricultural sustainability.

4 Existing and Proposed solution

Existing Solution:

1. Manual Weed Control: Farmers traditionally manually identify and remove weeds from their fields. This method is labor-intensive, time-consuming, and not always effective, especially in large-scale agriculture.

2. Herbicides: Chemical herbicides are commonly used to control weeds, but they can harm the environment and have resistance issues.

3. Satellite Imagery: Remote sensing and satellite imagery provide a broader view of fields, but may lack the fine-grained detail required for precise weed detection.

Proposed Solution:

1. Computer Vision and AI: Implement machine learning algorithms, including convolutional neural networks (CNNs), to analyze images of crops and weeds captured in the field. These systems can automatically identify and differentiate between the two.

2. Sensor-based Solutions: Develop sensor technologies, such as LiDAR or hyperspectral imaging, to capture data about plant characteristics, allowing for more accurate detection.

3. Robotics and Automation: Integrate AI-driven robots or drones equipped with cameras and precision tools to autonomously detect and remove weeds while leaving crops intact.

4. Mobile Apps: Create user-friendly mobile applications that allow farmers to capture images of their fields and receive real-time feedback on weed infestations and suggested actions.

5. IoT Integration: Utilize Internet of Things (IoT) devices to collect data on soil conditions, weather, and crop health, which can aid in more precise weed detection and management decisions.

6. Data Sharing Platforms: Develop platforms that enable farmers to share weed and crop data for collaborative research and decision-making.

The proposed solutions aim to enhance the efficiency of weed detection, reduce manual labor, optimize herbicide use, and ultimately increase crop yields while minimizing environmental impact.

4.1 Code submission (Github link):

-upskillcampus-/CropAndWeedDetection.ipynb at main · DivyaNGowda25/-upskillcampus- (github.com)

4.2 Report submission (Github link) :

-upskillcampus-/Project report.pdf at main · DivyaNGowda25/-upskillcampus- (github.com)

5 Proposed Design/ Model

This proposed design outlines a comprehensive crop and weed detection model that leverages data, technology and user engagement to optimize detection of crops and weeds under various conditions and through different types of crops. This design encompasses data management and user considerations to create a comprehensive and effective solution for modern agriculture.

5.1 High Level Diagram:

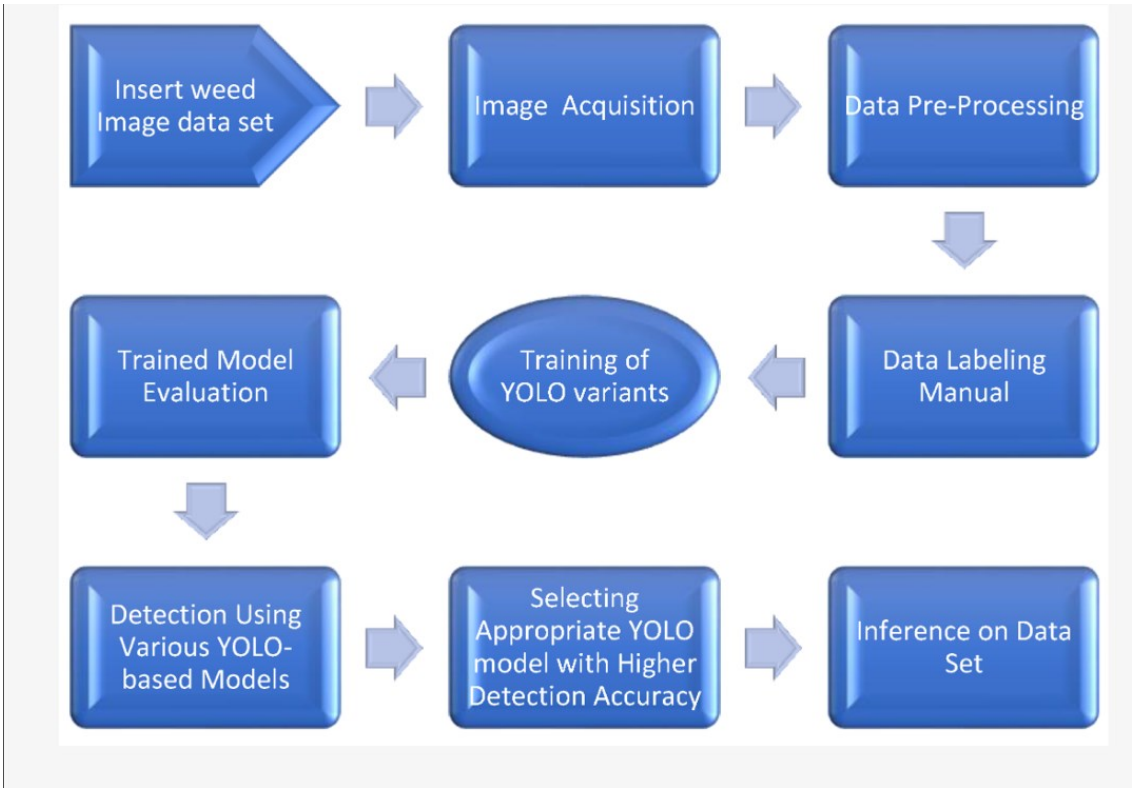


Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

6 Performance Test

Performance testing for crop and weed detection systems is crucial to ensure their accuracy and reliability in agricultural applications. Here's a brief overview of how to conduct performance testing for such a system:

1. Define Performance Metrics:- Start by defining clear performance metrics and objectives. These metrics can include response time, throughput, resource utilization (CPU, memory, bandwidth), and system stability under heavy loads.

2. Load Testing:- Conduct load testing to assess how the system behaves under expected image loads. This involves gradually increasing the number of simulated users or devices to measure performance thresholds.

3. Stress Testing:- Perform stress testing to evaluate how the system handles extreme conditions beyond its normal capacity. This helps identify breaking points and weaknesses.

Performance of crop and weed detection systems can vary depending on the specific environment and conditions in which they are deployed. Regular testing and refinement are essential to maintain accuracy and reliability in agricultural applications.

6.1 Test Plan/ Test Cases

1. Objective: Stating the objectives of test plan, such as evaluating the accuracy, robustness, and real-world performance of the crop and weed detection system.
2. Test Environment: Specifying the testing environment, including the geographical location, weather conditions, and any relevant details about the agricultural setting where the system will be deployed.
3. Test Scenarios: Define the specific scenarios and conditions under which the detection system will be tested which includes different crop types, weed variability.

6.2 Test Procedure

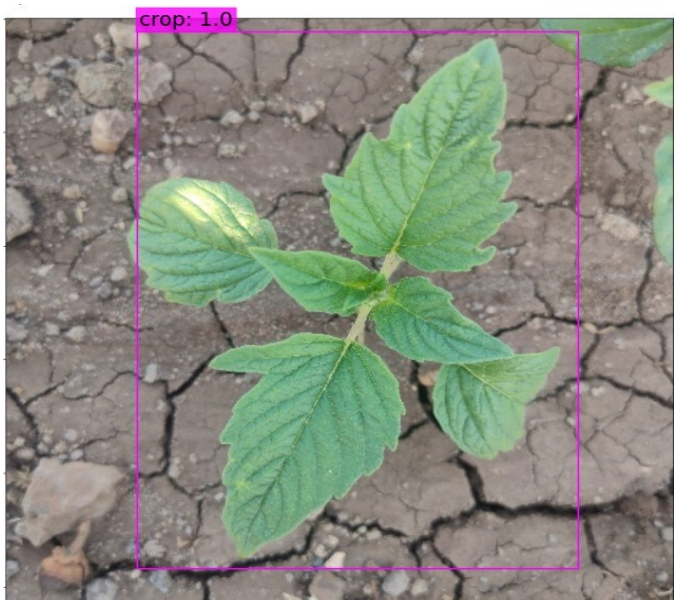
1. Data Collection:- Collecting image data from various sources, including crop and weed under different light conditions. This data serves as a baseline for comparison.

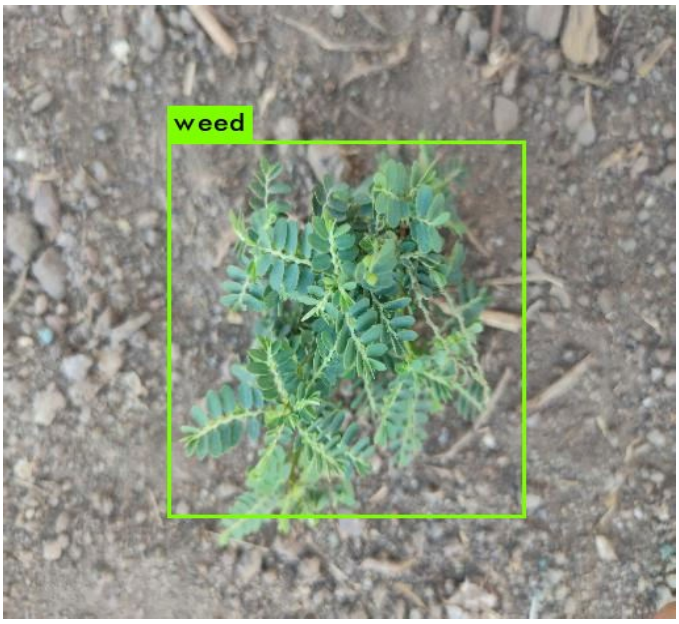
2. Simulation:- Deploying the trained detection model in the test environment and executing the detection system under different conditions.

3. Pattern Optimization:- Using Data science and Machine Learning algorithms for detection of crop and weed.

4. Real-world Testing: - Test the system under real-world environmental challenges. Conducting tests in the presence of factors like wind, rain, or dust, which can affect the system's performance. Ensuring the system can still accurately detect weeds despite these challenges and analyzing the data collected from both the simulation and real-world testing phases.

6.3 Performance Outcome





7 My learnings

My involvement in the project to detect crop and weed as a data scientist provides with valuable skills and experiences that can significantly contribute to your career growth. Here are some of the key learnings and their potential impact on my career:

1. Understanding Agricultural Practices:- Gain knowledge of agricultural practices, including crop types, growth stages, and common weed species.= and studying the challenges faced by farmers in crop management and weed control, are highly transferable to various industries, including finance, healthcare, and e-commerce.

2. Computer Vision and Machine Learning:- Developing expertise in computer vision and machine learning, which are fundamental to building detection models. Studying object detection algorithms like YOLO, Faster R-CNN.

3 .Data Collection and Annotation:- Learning how to collect and preprocess data for training detection models, including acquiring images or sensor data and understanding data annotation techniques for labeling crops and weeds in datasets.

4 .Real-Time Decision Making:- Studying how to develop systems that enable real-time decision-making for farmers based on detection results and learning about AI-driven decision support tools for optimizing crop management.

Learning in crop and weed detection is an ongoing process that involves a combination of formal education, practical experience, and staying informed about industry developments. Continuous learning and a multidisciplinary approach are key to success in this field.

8 Future work scope

The future scope for crop and weed detection holds great potential for innovation and advancements. As technology continues to evolve, there are several exciting directions and opportunities for further development in this field:

1. Improved Accuracy and Precision:
   - Enhance the accuracy and precision of detection algorithms through the use of advanced machine learning techniques, such as deep learning and reinforcement learning.
   - Develop more sophisticated models that can identify crops and weeds with higher reliability, reducing false positives and negatives.

2. Multi-Spectral Imaging:
   - Utilize multi-spectral and hyperspectral imaging technologies to capture a wider range of data about crops and weeds.
   - Analyze different wavelengths of light to gain insights into plant health, stress levels, and nutrient deficiencies.

3. Automation and Robotics:
   - Integrate crop and weed detection systems with autonomous agricultural machinery, such as robotic weeders and harvesters.
   - Enable real-time decision-making by allowing machines to autonomously identify and manage crops and weeds.

4. IoT and Sensor Networks:
   - Deploy sensor networks and Internet of Things (IoT) devices in agricultural fields to continuously monitor crops and detect weeds.
   - Use real-time data from sensors to optimize irrigation, fertilization, and pest control strategies.

The future of crop and weed detection is exciting, with the potential to revolutionize agriculture by increasing efficiency, reducing resource consumption, and promoting sustainable farming practices. As technology continues to advance, these developments will contribute to addressing global food security challenges and ensuring a more sustainable future for agriculture.