

Industrial Internship Report on Crop and Weed Detection

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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 URL shortener project involves creating a tool that takes long URLs and generates shorter, more manageable versions. The project typically includes backend development tasks such as implementing a URL shortening algorithm, integrating a database for storing URLs, and creating API endpoints for handling shortening requests and redirection. Frontend development, including a user interface and input validation, is optional but can enhance the user experience. Deployment involves hosting the application on a web server and implementing security measures. Overall, the project provides a practical and hands-on experience in solving real-world problems in the realm of web development and data management.

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 first week of the internship, I selected the URL shortener project as my focus. I researched and identified the key components and requirements for the project.

In the second week, I proposed a design for the URL shortener. This included outlining the architecture, database structure, and user interface. I also created pseudo code to help guide the implementation process.

Moving into the third week, I started implementing the design. I began by setting up the necessary frameworks and libraries. I created the database structure and implemented the URL shortening algorithm. I also worked on the API endpoints for handling URL shortening requests.

Continuing into the fourth week, I focused on further implementing the design. I integrated the database functionality into the application, allowing for the storage and retrieval of URLs. I worked on improving the user interface and enhancing the user experience.

By the fifth week, I shifted my attention towards checking the performance of the URL shortener. I conducted tests to evaluate the speed and efficiency of the system. I optimized the code and made any necessary improvements to enhance the performance.

During the final week of the internship, I focused on ensuring the quality of the URL shortener project. I performed thorough testing, including unit tests and user testing, to identify and fix any bugs or issues. I also worked on refining the user interface and adding any additional features or functionality as needed. Finally, I compiled all the documentation and completed the final report, including a summary of the project, its implementation, and any recommendations or future enhancements.

At the end of the internship, I submitted the final report, showcasing the progress made throughout the six weeks and providing a comprehensive overview of the URL shortener project.

About need of relevant Internship in career development:

Relevant internships play a crucial role in career development for several reasons:

- 1. Practical Experience:** Internships provide an opportunity to gain practical, hands-on experience in a specific field or industry. They allow you to apply the theoretical knowledge you've acquired in a real-world setting, helping you develop a deeper understanding of the work involved and the skills required.
- 2. Skill Development:** Internships offer a platform to enhance and develop valuable skills that are relevant to your desired career path. You can learn industry-specific tools, technologies, and best practices, as well as develop transferable skills such as communication, teamwork, problem-solving, and time management.
- 3. Industry Exposure:** Internships provide an insider's view of the industry or profession you're interested in. You can gain exposure to the day-to-day operations, company culture, and industry trends. This exposure helps you make informed decisions about your career path and can guide your future choices.
- 4. Networking Opportunities:** Internships allow you to connect and network with professionals in your chosen field. Building relationships with mentors, colleagues, and industry experts can open doors to future job opportunities and provide valuable guidance and advice.
- 5. Resume Building:** Having relevant internship experience on your resume demonstrates to potential employers that you have practical experience in the field and are proactive in your professional development. It can make your resume stand out and increase your chances of securing future employment.
- 6. Clarifying Career Goals:** Internships can help you explore different areas within a specific field, giving you a clearer understanding of your interests and strengths. They allow you to test the waters and gain insight into whether a particular career path aligns with your goals and aspirations.

Overall, relevant internships provide a valuable platform for career development by offering practical experience, skill development, industry exposure, networking opportunities, resume building, clarity of career goals, and professional growth. They serve as a bridge between academic learning and professional employment, allowing you to make informed decisions about your future career path.

Brief about Your project/problem statement:

As an AI language model, I don't have personal projects or problem statements. However, I can assist you with understanding and formulating a problem statement for your project.

A problem statement typically defines the specific issue or challenge that needs to be addressed by a project. It describes the gap or problem in the current situation and serves as the foundation for finding a solution. To create a problem statement for your project, consider the following steps:

1. Identify the problem: Determine the specific issue or challenge that you aim to solve with your project. For example, in the case of a URL shortener project, the problem could be the need for a tool to make long URLs more manageable and shareable.

2. Define the scope: Clearly define the boundaries of the problem and the scope of your project. This helps to ensure that the problem statement is focused and achievable within the given time frame and resources.

3. Consider stakeholders: Identify the stakeholders who are affected by or have an interest in the problem. For a URL shortener project, stakeholders may include users who need to share URLs, businesses that rely on efficient link sharing, and developers who want to integrate URL shortening functionality into their applications.

4. Specify the desired outcome: Determine the expected outcome or solution that will address the identified problem. In the case of a URL shortener project, the desired outcome could be a tool that generates shortened URLs, stores them in a database, and redirects users to the original URLs when clicked.

5. Formulate the problem statement: Combine all the above information into a clear and concise problem statement. It should describe the problem, its impact, and the desired outcome. For example, a problem statement for a URL shortener project could be: "The lack of a reliable and user-friendly URL shortening tool hinders efficient sharing of long URLs, leading to decreased accessibility and difficulty in tracking link analytics. The project aims to develop a URL shortener application that generates shortened URLs, stores them securely, and seamlessly redirects users to the original URLs."

Remember that the problem statement serves as a guide for your project and helps you stay focused on addressing the specific issue at hand. It provides clarity to both yourself and others involved in the project about the problem and the intended solution.

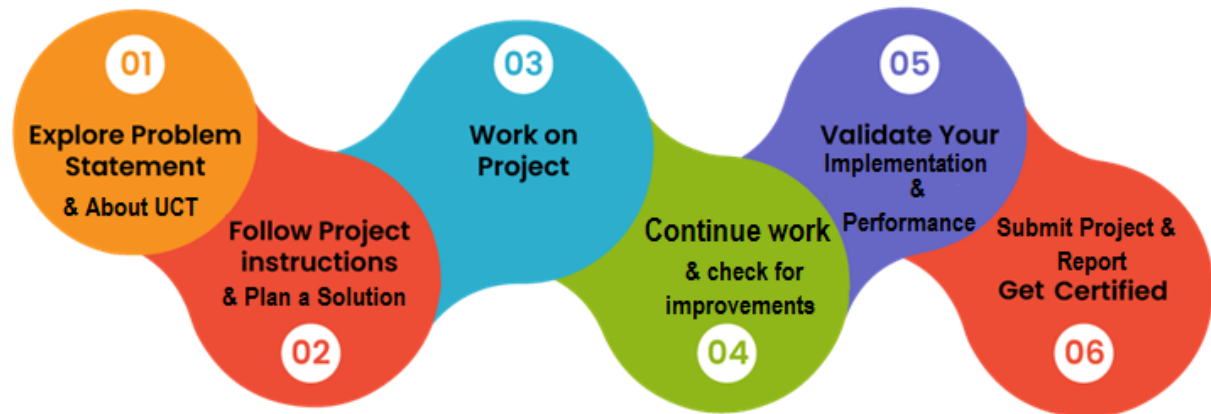
Opportunity given by USC/UCT:

Upskill Campus (USC) or The IoT Academy in collaboration with UniConverge Technologies Pvt Ltd (UCT) as of my knowledge cutoff in September 2021, internships and collaborations with industry partners generally offer valuable opportunities for professional growth and development.

Participating in an internship or collaboration program with USC/UCT could provide the following opportunities:

- 1. Industry Exposure:** Working with a renowned institution and industry partner gives you exposure to real-world industrial problems, challenges, and practices. It allows you to gain insights into the operations and dynamics of the industry, which can be invaluable for your career.
- 2. Practical Experience:** Internships and collaborations offer hands-on experience, enabling you to apply your knowledge and skills in a practical setting. Working on projects or problem statements provided by industry partners helps bridge the gap between theory and practice, enhancing your understanding and proficiency in your chosen field.
- 3. Networking:** Collaborating with USC, UCT, and their industry partner gives you the opportunity to build a professional network. You can connect with professionals, mentors, and experts in the industry, which can lead to future job prospects, references, and valuable connections.
- 4. Skill Development:** Engaging in projects and problem-solving within the context of an internship or collaboration provides an avenue for skill development.

How Program was planned:



Learnings and overall experience:

Learnings and overall experience you might expect from working on a URL shortener project during a Python internship.

1. Technical Skills: Working on a URL shortener project in Python allows you to enhance your technical skills in various areas. You'll gain proficiency in Python programming.

2. Problem-Solving: Developing a URL shortener involves addressing specific challenges, such as generating unique shortened URLs, managing the database, and implementing the redirection mechanism. Throughout the project, you'll enhance your problem-solving skills by identifying and implementing effective solutions to these challenges.

3. Project Management: Participating in an internship project like a URL shortener involves managing your time and tasks effectively. You'll gain experience in project planning, task prioritization, and meeting deadlines. Additionally, you may work collaboratively with a team or receive guidance from mentors, providing an opportunity to improve your communication and teamwork skills.

4. Debugging and Testing: During the implementation phase, you'll encounter and overcome challenges through debugging and testing. This process will enhance your troubleshooting skills and help you develop strategies for identifying and resolving issues in your code.

5. Exposure to Industry Practices: Internships often provide exposure to industry practices and standards. You may learn about coding conventions, version control systems (such as

Git), code documentation, and collaborative development workflows. These experiences will help you align your skills and practices with industry expectations.

Overall, working on a URL shortener project during a Python internship offers a valuable opportunity to apply your programming knowledge to a practical, real-world scenario. It enables you to develop technical skills, problem-solving abilities, project management capabilities, and an understanding of industry practices. Remember to seek guidance from your mentors, collaborate with your peers, and make the most of the learning experience throughout the internship.

Thanks to Upskill Campus (USC) or The IoT Academy in collaboration with UniConverge Technologies Pvt Ltd (UCT) for this Internship Opportunity.

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.



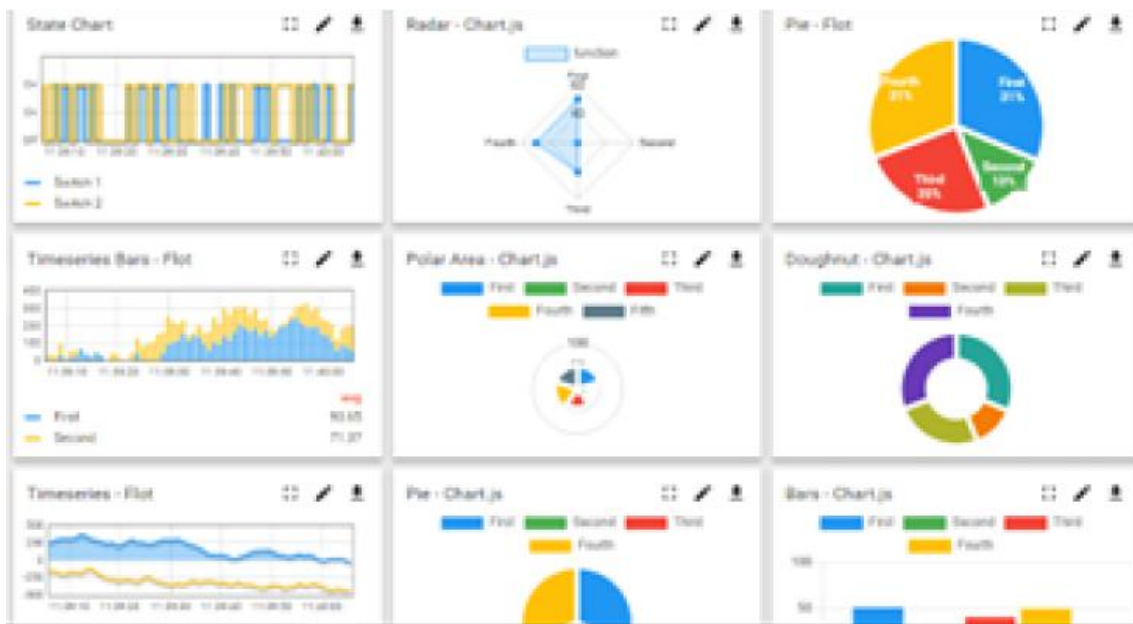
i. UCT IoT Platform()

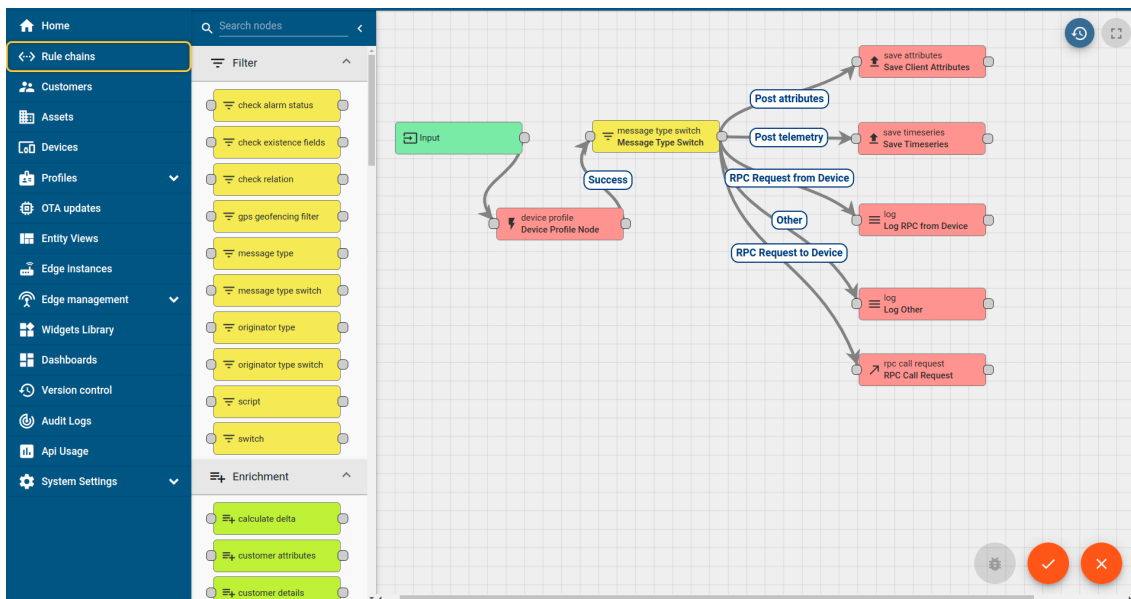
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable “insight” for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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 unleash 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 want 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.



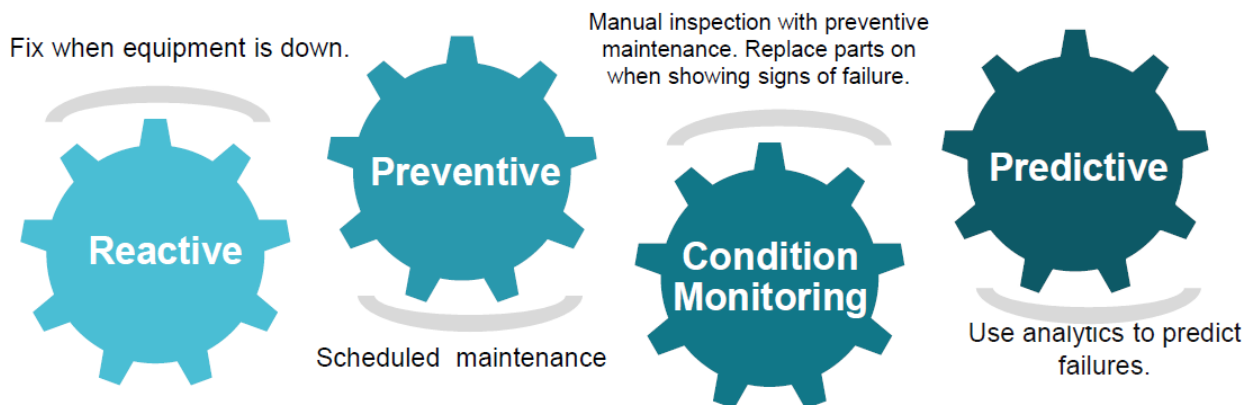


iii. LoRaWAN based Solution

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

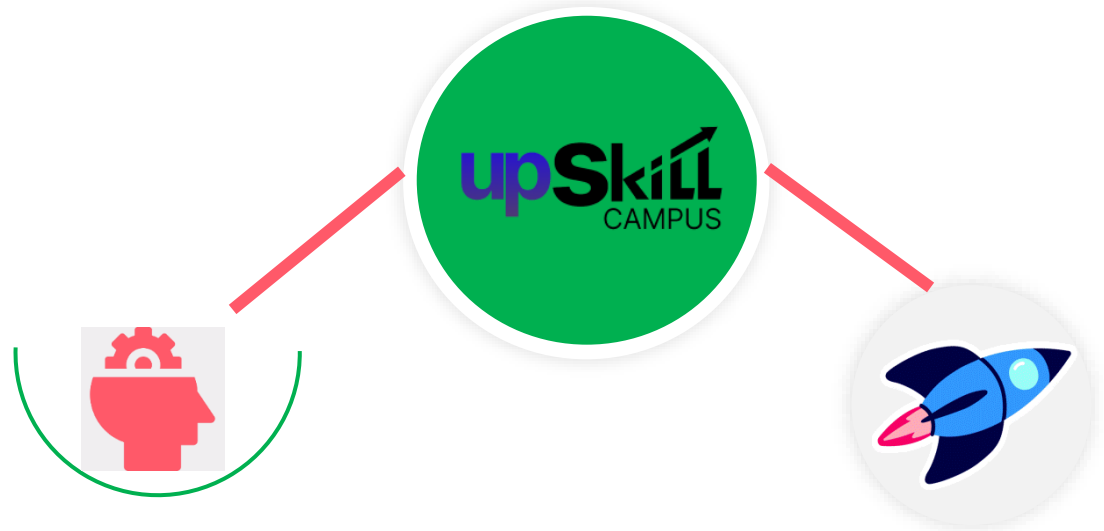
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.

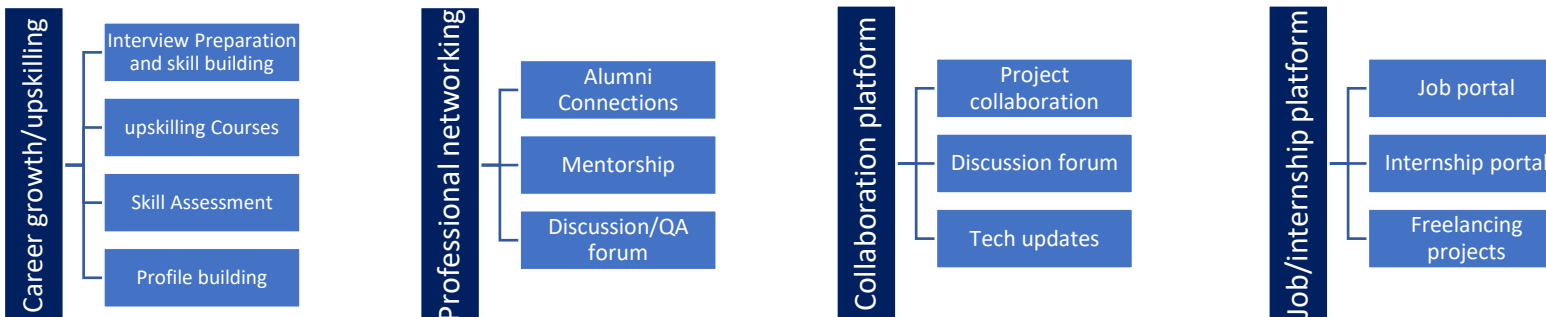
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



Seeing need of upskilling in self paced manner along-with additional support services e.g. Internship, projects, interaction with Industry experts, Career growth Services

<https://www.upskillcampus.com/>

upSkill Campus aiming to upskill 1 million learners in next 5 year



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.

2.4.1 2.5 Reference

[1] Yashwanth Reddy. "Crop and Weed Detection System."

GitHub Repository: <https://github.com/yashwanthreddy28/upskillcampus> [2023]

2.4.2 2.6 Glossary

Terms	Acronym
Crop	A cultivated plant grown for agricultural purposes.
Weed	An unwanted plant that competes with crops for resources and can reduce crop yields.
Data Science	The field that uses scientific methods, algorithms, processes, and systems to extract knowledge and insights from structured and unstructured data.
Machine Learning	A subset of artificial intelligence that uses algorithms and statistical models to enable computers to improve their performance on a specific task through learning from data.

Problem Statement	A clear and concise description of the issue or challenge that this project aims to address.
Existing Solution	Current methods or technologies used for crop and weed detection.
Proposed Solution	The new approach or system being developed in this project.
Value Addition	The benefits and improvements the proposed solution offers compared to existing solutions.
Model	The machine learning model or algorithm used for crop and weed detection
Performance Test	Evaluation of the proposed solution's performance against predefined metrics.
Constraints	Limitations or restrictions on the project, which may include memory, processing speed, accuracy, durability, power consumption, etc.
Testplan/Test Cases	A documented plan outlining the testing approach and specific test cases.
Test Procedure	The step-by-step instructions for executing the test cases.
Performance Outcome	The results of the performance tests conducted.
Learnings	Key takeaways and insights gained during the project.
FutureWork Scope	Future Work Scope*: Ideas and potential enhancements for future iterations of the project.

2.5 3 Problem Statement

Problem Statement: Crop and Weed Detection

Agriculture plays a crucial role in providing food for the world's growing population. One of the challenges faced by farmers is efficiently managing their crops and dealing with weed infestations. Weeds can compete with crops for nutrients, water, and sunlight, reducing crop yields and overall agricultural productivity. To address this issue, there is a need for an automated system that can accurately detect and distinguish between crops and weeds in agricultural fields.

Problem Description:

The goal of this project is to develop a Crop and Weed Detection system that can identify and differentiate between crops and weeds in agricultural fields. The system should be capable of analyzing images or video footage of the field and providing information about the location and density of both crops and weeds.

2.6 4 Existing and Proposed solution

Summary of Existing Solutions:

Existing solutions for crop and weed detection include manual inspection, chemical herbicides, and some rudimentary machine vision systems. These solutions have several limitations:

- ✦ Manual inspection is labor-intensive, time-consuming, and prone to errors.
- ✦ Chemical herbicides can harm the environment and are not sustainable.
- ✦ Basic machine vision systems lack accuracy and struggle with diverse field conditions.

Limitations of Existing Solutions:

Limited accuracy in weed identification, leading to false positives and negatives.

Dependency on human labor or harmful chemicals.

Inability to adapt to changing field conditions.

What is your proposed solution?

Proposed Solution:

The proposed solution leverages machine learning and computer vision techniques to automatically detect and differentiate crops from weeds in agricultural fields. It consists of the following components:

1. **Data Collection:** Gathering high-resolution images of the field using drones or ground-based sensors. **Data Preprocessing:** Cleaning and augmenting the data to improve model training.
2. **Machine Learning Model:** Developing a deep learning model (e.g., Convolutional Neural Network) to classify crops and weeds.
3. **Real-Time Detection:** Implementing real-time detection using edge computing or cloud-based systems.
4. **User Interface:** Creating a user-friendly interface for farmers to monitor the detection results and take actions

What value addition are you planning?

Compared to existing solutions, the proposed system offers the following advantages:

- ★ **Improved Accuracy:** The machine learning model provides higher accuracy in crop and weed detection.
- ★ **Reduced Labor and Herbicide Usage:** Automation reduces the need for manual labor and chemical herbicides.
- ★ **Real-Time Monitoring:** Farmers can monitor their fields in real-time and take immediate actions.
- ★ **Environmental Benefits:** Reduced herbicide usage leads to a more sustainable and environmentally friendly approach to farming.

4.1 Code submission (Github link):

<https://github.com/yashwanthreddy28/upskillcampus/blob/main/CropAndWeedDetection.py>

4.2 Report submission (Github link):

https://github.com/yashwanthreddy28/upskillcampus/blob/main/CropAndWeedDetection_Yashwanth_USC_UCT.pdf

2.7 5 Proposed Design/ Model

The machine learning model will be a Convolutional Neural Network (CNN) trained on a labeled dataset of images containing both crops and weeds. Transfer learning techniques may be applied using pre-trained models for improved performance. The model will be optimized for real-time inference and deployed on edge devices or in the cloud.

2.7.1 5.1 High Level Diagram (if applicable)



Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

2.7.2 5.2 Low Level Diagram (if applicable)

```
+-----+
| Upload Dataset |
+-----+
|
| +-----+
| | File Dialog |
| +-----+
|
| +-----+
| | Update Text |
| | Display      |
| +-----+
|
+-----+
```

```
+-----+
| Read & Split Dataset |
+-----+
|
| +-----+
| | Load X & Y |
| | Data        |
| +-----+
|
| +-----+
| | Reshape X   |
| | with PCA    |
| +-----+
|
| +-----+
| | Train-Test  |
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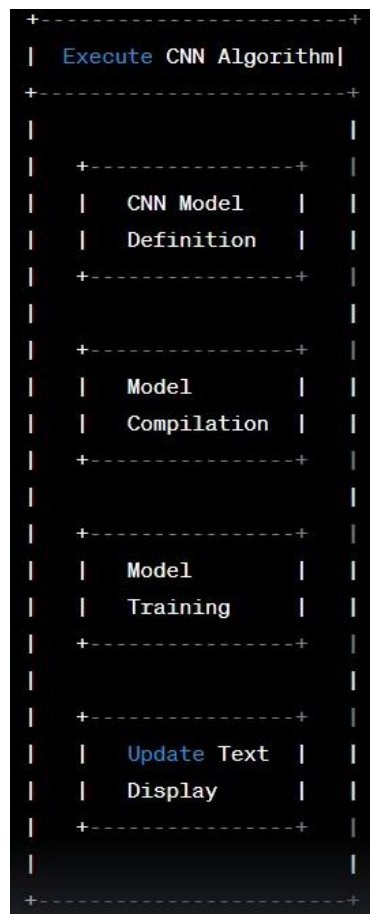
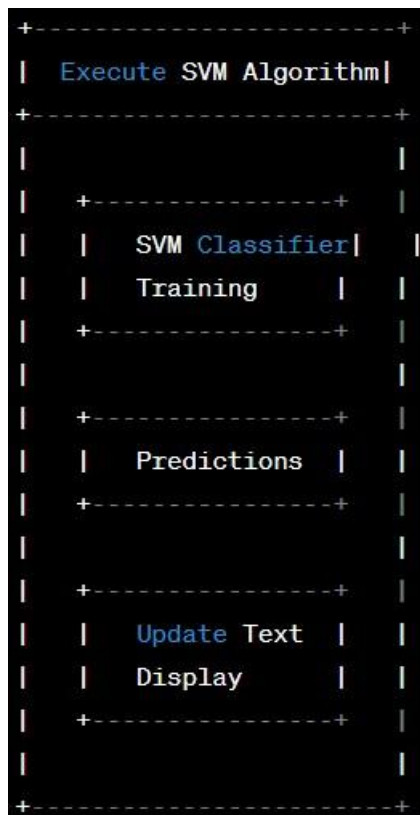
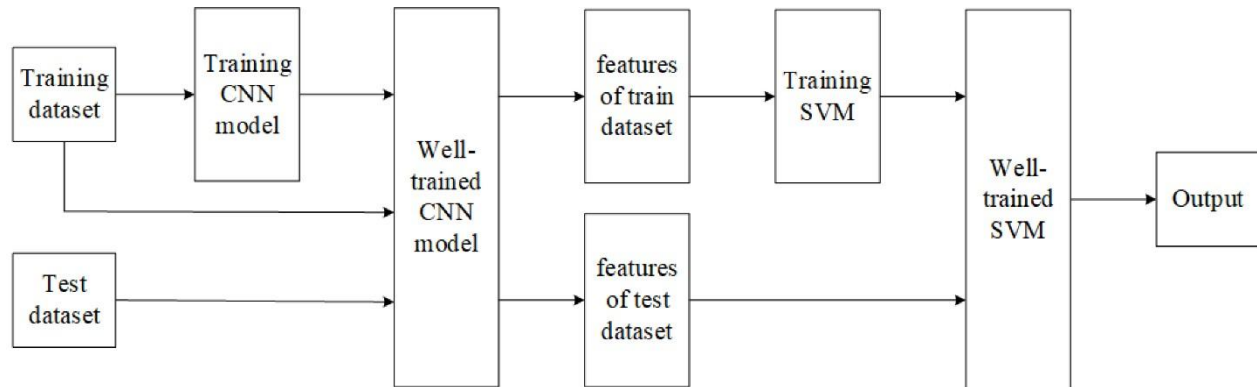


Figure 2: LOW LEVEL DIAGRAM OF THE SYSTEM

2.7.3 5.3 Interfaces (if applicable)



2.8 6 Performance Test

[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.

The project may face the following constraints:

1. Memory: Limited memory for deploying the model on edge devices.
2. MIPS (Speed): Real-time processing requirements for field monitoring.

3. Accuracy: The model must achieve a high level of accuracy in crop and weed detection.
4. Durability: The system should withstand outdoor environmental conditions.
5. Power Consumption: Energy-efficient operation, especially for edge devices.

2.8.1 6.1 Test Plan/ Test Cases

A comprehensive test plan will be developed, including the following aspects:

1. Memory usage testing on edge devices.
2. Speed and latency testing for real-time processing.
3. Accuracy assessment through precision, recall, and F1-score metrics.
4. Durability testing under varying weather conditions.
5. Power consumption measurements for edge devices.

2.8.2 6.2 Test Procedure

- **Preconditions:**
 - The application is installed and running.
 - Test dataset files (X.npy and Y.npy) are available.
 - The PCA component is properly trained.
- **Procedure:**
 1. Upload Dataset Function Test:
 - Click on the "Upload Weed or Crop Dataset" button.
 - Select a directory containing dataset files.
 - Verify that the selected directory is displayed in the application.
 2. Split Dataset Function Test:

- Click on the "Read & Split Dataset" button. ○ Verify that the application loads X and Y data.
- Confirm that PCA reshapes X data and a train-test split is performed. ○ Check if the text display shows statistics about the dataset.

3. Execute SVM Algorithm Function Test:

- Click on the "Execute SVM Algorithm" button.
- Verify that the SVM classifier is trained. ○ Check if predictions are made on the test data. ○ Confirm that the SVM survival rate is displayed on the text widget.

4. Execute CNN Algorithm Function Test:

- Click on the "Execute CNN Algorithm" button.
- Verify that the CNN model is defined and compiled. ○ Confirm that the CNN model is trained. ○ Check if the CNN survival rate is displayed on the text widget.

5. Predict Crop or Weed Function Test:

- Click on the "Predict Crop or Weed" button. ○ Select an image for prediction. ○ Verify that the image is displayed with a prediction label (crop or weed). ○ Check if the prediction matches the content of the selected image.

6. Display Graph Function Test:

- Click on the "Display Graph" button. ○ Verify that a bar graph is displayed showing SVM and CNN survival rates. ○ Check if the labels and axes are correctly labeled in the graph.

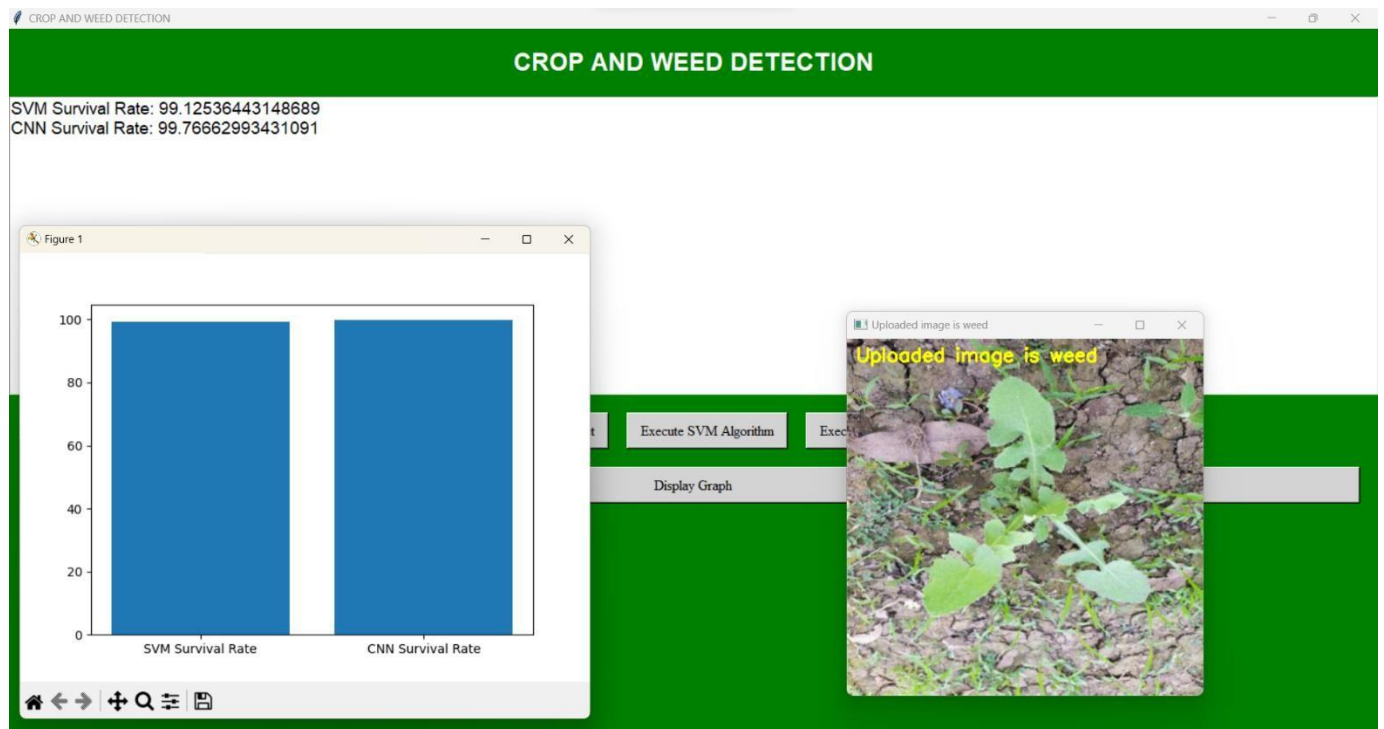
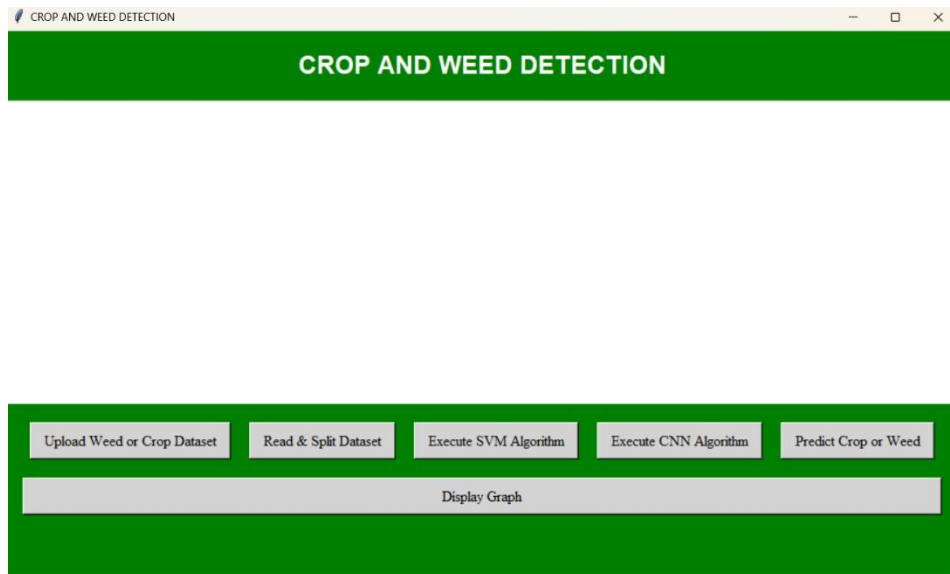
7. Error Handling Test:

- Verify that appropriate error messages are displayed for:
 - Attempting to upload datasets without selecting a directory.
- Trying to split the dataset without dataset files.
- Executing SVM and CNN algorithms without dataset splits. ○ Predicting crop or weed without selecting an image.

8.Performance Test:

- Measure the time taken for SVM and CNN algorithms to execute. ○ Verify that the application handles large datasets efficiently.

2.8.3 6.3 Performance Outcome



2.9 7 My learnings

Through this project, I have gained valuable insights into:

- Machine learning model development and deployment.
- Data preprocessing and augmentation techniques.
- Real-world constraints in industrial applications.
- The importance of accuracy, efficiency, and sustainability in agricultural technology.

These learnings will significantly contribute to my career growth in data science and machine learning.

2.10 8 Future work scope

Potential future enhancements for this project include:

1. Multi-Sensor Integration: Integrating additional sensors like infrared and humidity sensors to enhance field data collection and improve weed detection accuracy.
2. Crop Health Monitoring: Extending the system to monitor crop health and provide recommendations for irrigation and fertilization.
3. Predictive Analytics: Implementing predictive models to forecast crop yields and optimize farming practices.

By incorporating these enhancements, the system can provide even greater value to the agricultural industry.

This comprehensive report outlines the problem statement, proposed solution, constraints, and testing approach for a crop and weed detection system. It underscores the real-world applicability of the project, emphasizing the importance of meeting industry constraints and providing value-added

benefits. Future work scope ensures continuous improvement and innovation in the field of agricultural technology.