Industrial Internship Report on

Full Stack App Development

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 is related to Agriculture as it plays a vital role in the development of our country. Some issues concerning agriculture have been always hindering the development of our country. So I had to Develop a project related to smart agriculture IOT devices that can be used to offer assistance to farmers in getting Live Data Temperature, Humidity, Soil Moisture, and Soil Temperature for efficient environment monitoring which will enable them to increase their overall yield and quality of products This internship gave me a very good opportunity to get exposure to Industrial problems and to 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.

Weeks 1-2 Overview: The initial focus was on familiarizing oneself with USC_TIA, Python projects, and understanding Android Studio for full-stack app development. Key achievements included becoming proficient in USC_TIA, contributing to the TicTacToe project, and gaining foundational knowledge in Android Studio.

Weeks 1-2 Achievements:

- Explored USC_TIA documentation and executed basic tasks.
- Contributed to the TicTacToe project, expanding it to accommodate multiple players and larger board sizes.
- Acquired proficiency in essential Java/kotlin libraries and Full Stack app development.
- Developed a Unit Converter app in Android Studio.

Weeks 1-2 Challenges:

- Encountered challenges with USC_TIA integration and Android Studio app development complexity.
- Overcame challenges through troubleshooting, seeking guidance, and learning resources.

Weeks 1-2 Learning Resources:

- Utilized USC_TIA documentation, webinars, and online tutorials for learning.
- Engaged with various learning resources for Android Studio and Full Stack app development.

Weeks 1-2 Next Week's Goals:

- Address integration challenges with USC_TIA.
- Tackle more complex tasks in Full Stack app development project.

Weeks 3 Overview: Focused on deepening understanding of Java programming language and exploring IoT components for integration into the Android app. Conducted small projects to apply Java concepts and explore IoT integration possibilities.

Weeks 3 Achievements:

- Deepened understanding of Java programming language and IoT components.
- Conducted small projects to apply Java concepts and integrate IoT devices with Firebase for testing.

Weeks 3 Challenges: Encountered challenges with IoT devices not connecting to the cloud properly, code issues, and longer compilation times. Addressed challenges through continuous work, experimentation, testing, and correction.

Weeks 3 Lessons Learned: Learned valuable lessons in problem-solving, resilience, perseverance, flexibility, and the intricacies of IoT integration.

Weeks 4 Overview: Focused on integrating the ESP32 module with an Android app and Firebase for remote LED control. Achieved significant progress in enhancing functionality and control of the LED bulb remotely. Since I could control led This means I could control any machine also read the sensor data and display them so for prototype and limited time my app can control an 1 led

Weeks 4 Achievements:

- Successfully connected an LED to the ESP32 module and integrated it with Firebase Realtime Database.
- Enabled remote LED control via the internet using an Android app.
- Implemented HTTP for efficient message exchange and optimized response time.
- Addressed challenges through troubleshooting and innovative problem-solving.

Weeks 4 Challenges: Encountered challenges with ESP32 connection, large package size, and technical issues with Firebase integration. Resolved challenges through experimentation, optimization, and collaboration.

Weeks 4 Lessons Learned: Gained insights into adaptability, troubleshooting skills, resourcefulness, optimization, problem-solving strategies, and collaboration.

About need of relevant Internship in career development.

1. **Practical Experience**: Gain hands-on experience in real-world work environments.
2. **Skill Development**: Develop and refine specific industry-relevant skills.

3. **Industry Insights**: Gain insights into industry trends, practices, and cultures.
4. **Networking Opportunities**: Build professional networks with industry professionals.
5. **Resume Building**: Enhance resume attractiveness to potential employers.
6. **Career Exploration**: Explore different roles, industries, and career paths.
7. **Professional Development**: Receive feedback, mentorship, and opportunities for growth.

Brief about project/problem statement.

Agriculture is a cornerstone of economic development, yet numerous challenges impede its progress. To address these challenges, we propose the development of a Smart Agriculture IoT system aimed at assisting farmers in monitoring environmental conditions crucial for crop growth. By providing real-time data on temperature, humidity, soil moisture, and soil temperature, this system will enable farmers to make informed decisions, optimize resource utilization, and enhance crop yield and quality.

Objectives:

1. Develop IoT devices for real-time data collection.
2. Design a communication infrastructure for data transmission.
3. Create a user-friendly interface for data visualization.
4. Implement data analytics algorithms for insights.
5. Conduct field trials to validate system effectiveness.
6. Provide training and support for farmer adoption.

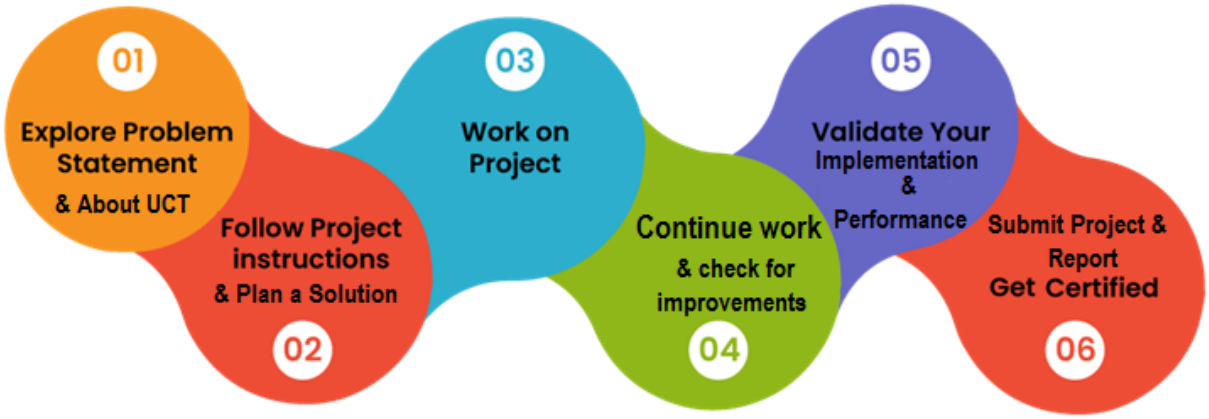
Expected Outcomes:

1. Improved crop monitoring capabilities.
2. Enhanced decision-making based on data insights.
3. Increased crop yield and quality.
4. Sustainable farming practices and resource efficiency.

Opportunity given by USC/UCT.

the opportunities provided by USC/UCT encompass hands-on project contributions, access to learning resources, troubleshooting challenges, and participation in field trials, offering interns valuable experiences for their career development.

How Program was planned



Learnings and overall experience.

My overall experience with USC/UCT has been incredibly enriching and rewarding. The opportunities provided not only allowed me to enhance my technical skills but also equipped me with valuable soft skills such as problem-solving, collaboration, and adaptability. Contributing to real-world projects, troubleshooting integration challenges, and participating in field trials provided practical insights into industry practices and challenges. The support from mentors, access to learning resources, and the opportunity to engage with a diverse community of peers further enhanced my learning experience. Overall, my internship experience with USC/UCT has been instrumental in my professional development, and I am grateful for the invaluable opportunities and experiences gained throughout the journey.

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.

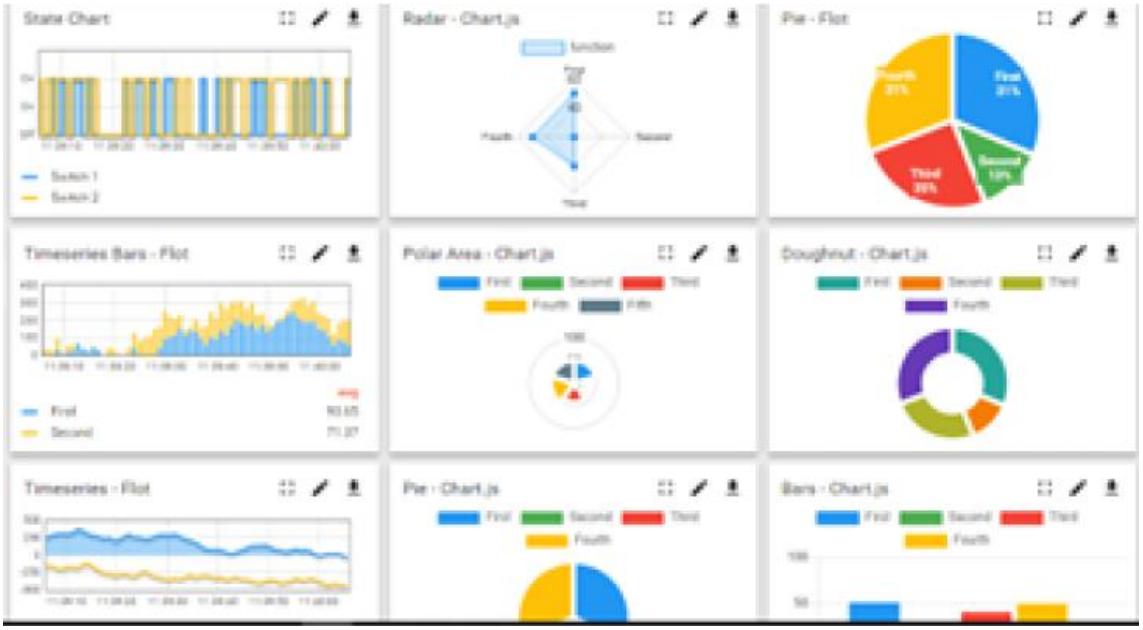
i. UCT IoT Platform (uct Insight)

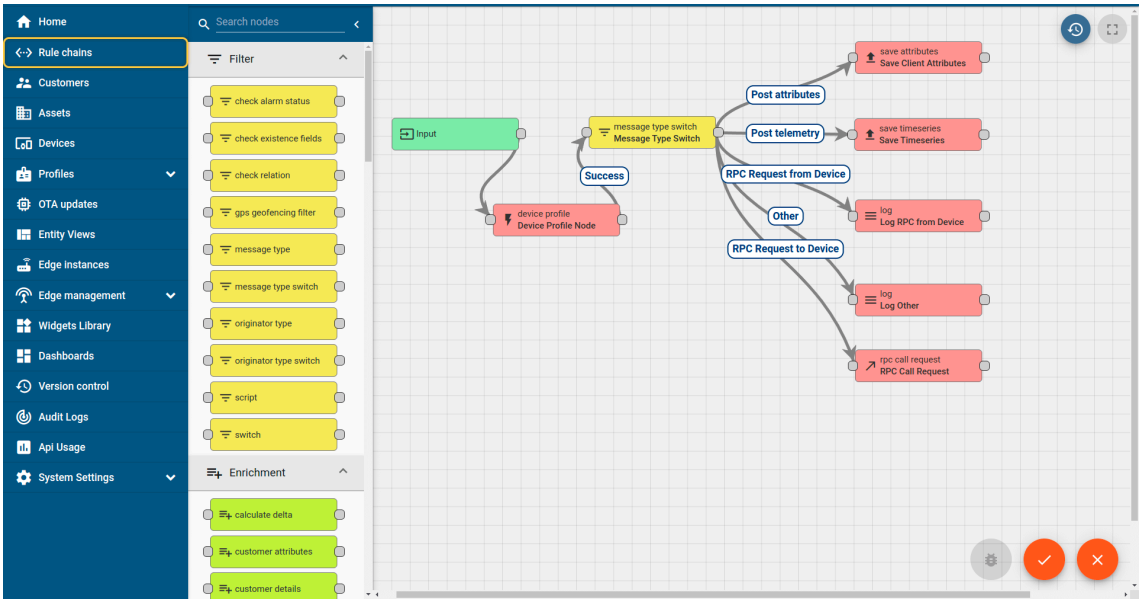
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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.

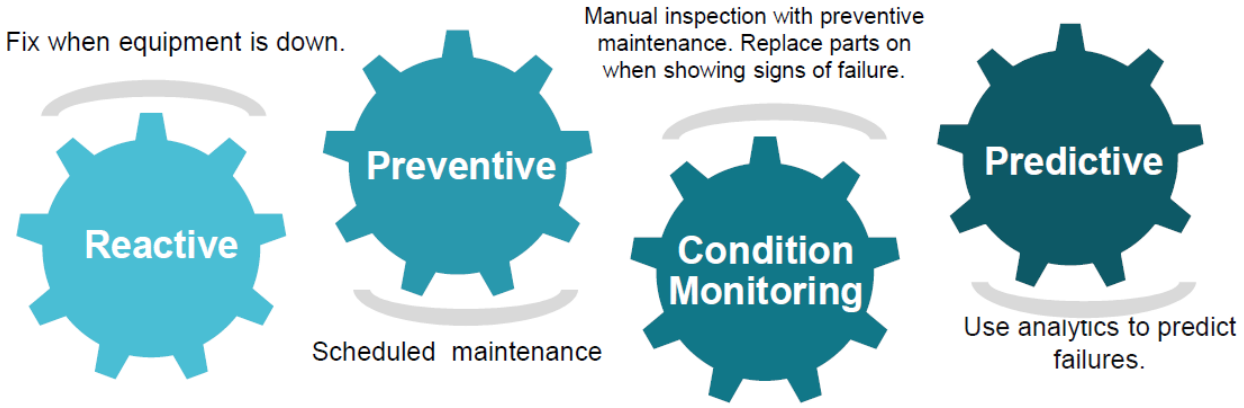
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1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

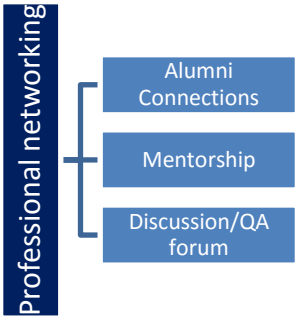
upskill Campus along with The IoT Academy and in association with Uniconverge technologies has facilitated the smooth execution of the complete internship process.

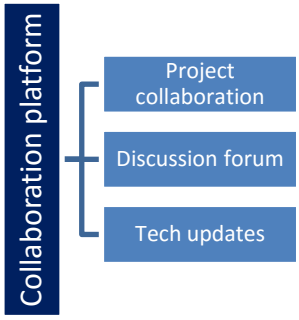
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.

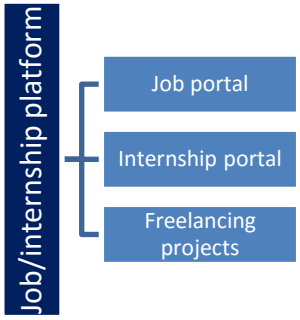
Seeing need of upskilling in self paced manner along-with additional support services e.g. Internship, projects, interaction with Industry experts, Career growth Services

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.

Reference

Android Developer Documentation: https://developer.android.com/docs
Official documentation provided by Google for Android app development.
Firebase Documentation: https://firebase.google.com/docs
Comprehensive documentation for Firebase, a cloud-based platform that provides various services for mobile and web app development.
MQTT Essentials: https://www.hivemq.com/mqtt-essentials/
A guide to MQTT (Message Queuing Telemetry Transport) protocol, explaining its fundamentals, concepts, and usage scenarios.
LoRaWAN Documentation: https://www.lora-alliance.org/what-is-lora/technology
Overview of LoRaWAN technology, including its architecture, features, and applications.

2.5 Glossary

Terms	Acronym
AVD	Android Virtual Device
ESP32	Espressif Systems' ESP32 microcontroller
HTTP	Hypertext Transfer Protocol
AWS	Amazon Web Services
XML	Extensible Markup Language
MQTT	Message Queuing Telemetry Transport
APK	Android Application Package

Problem Statement

The problem statement revolves around addressing persistent challenges faced in agriculture, hindering its overall development. Agriculture, being a cornerstone of economies, confronts obstacles that impede progress. To surmount these challenges, there's a pressing demand for innovative solutions leveraging technology. The proposed solution focuses on utilizing smart agriculture IoT devices to optimize crop monitoring, water management, thereby increasing yield and product quality.

Key Points of the Combined Problem Statement:

1. **Importance of Agriculture**: Agriculture plays a pivotal role in the economic development of countries worldwide.
2. **Persistent Challenges**: Despite its significance, agriculture faces ongoing challenges such as inefficient monitoring and resource management, hindering its progress.
3. **Need for Smart Solutions**: To overcome these challenges, there's a critical demand for innovative solutions that harness the power of technology.
4. **Focus on IoT Devices**: The proposed solution centers on leveraging smart agriculture IoT devices to address the challenges faced by farmers, particularly in crop monitoring and water management.
5. **Objectives**: The primary objectives include gathering real-time data on crucial environmental factors such as temperature, humidity, soil moisture, soil temperature, and water levels.
6. **Enhancing Monitoring**: The solution aims to enhance crop monitoring capabilities by providing farmers with access to real-time data, enabling them to make informed decisions about water usage and crop health.
7. **Optimizing Water Management**: By analyzing the collected data, farmers can optimize water usage, resulting in efficient water management practices and improved crop yield and product quality.
8. **Expected Outcomes**: The expected outcomes encompass improved crop monitoring, enhanced decision-making processes, optimized water management, increased yield, and product quality, ultimately fostering sustainable farming practices.

In summary, the problem statement underscores the imperative need for technological interventions, particularly through the implementation of smart agriculture IoT devices, to address challenges in agriculture, including water management, thereby enhancing productivity and sustainability in the sector.

3 Existing and Proposed solution

Summary of Existing Solutions and Their Limitations:

1. **Traditional Irrigation Methods**:
    - **Existing Solutions**: Many farmers rely on traditional irrigation methods such as flood irrigation or manual watering.
    - **Limitations**: These methods are often inefficient, leading to water wastage and uneven distribution. They also require significant labor and may not account for specific crop needs or environmental factors.
2. **Automated Irrigation Systems**:
    - **Existing Solutions**: Some farmers use automated irrigation systems controlled by timers or sensors.
    - **Limitations**: While these systems offer improvements in water efficiency, they may lack real-time monitoring capabilities or intelligent decision-making. They may also be expensive to install and maintain, limiting accessibility for small-scale farmers.
3. **Weather Forecasting Apps**:
    - **Existing Solutions**: Farmers may use weather forecasting apps to plan irrigation schedules based on predicted weather conditions.
    - **Limitations**: While helpful for general planning, weather forecasts may not always be accurate or specific to local conditions. Additionally, these apps do not provide real-time data on soil moisture or crop health.

Proposed Solution:

Our proposed solution is to develop smart agriculture IoT devices equipped with sensors to monitor key environmental factors such as soil moisture, temperature, humidity, and water levels. These devices will be integrated with a cloud-based platform for real-time data collection and analysis. Farmers will have access to a mobile application or web dashboard to view data insights and receive actionable recommendations for irrigation and crop management.

Value Addition:

1. **Real-time Monitoring**: Our solution provides farmers with real-time data on soil and environmental conditions, allowing for timely and precise irrigation decisions.
2. **Data-driven Decision Making**: By analyzing collected data, our solution offers intelligent recommendations tailored to specific crop needs and local conditions, optimizing water usage and improving crop health.
3. **Accessibility**: We aim to design our solution to be user-friendly and accessible, catering to the needs of small-scale farmers and larger agricultural operations alike.
4. **Cost-effectiveness**: By leveraging IoT technology and cloud-based platforms, we aim to develop a solution that is cost-effective to implement and maintain, ensuring affordability for farmers.
5. **Sustainability**: Through efficient water management and improved crop health, our solution contributes to sustainable farming practices, reducing water wastage and environmental impact.

Overall, our proposed solution aims to address the limitations of existing methods by providing a comprehensive, data-driven approach to smart agriculture, ultimately enhancing productivity, sustainability, and profitability for farmers.

3.1 Code submission (https://github.com/Intel-sense/upskillcampus)

3.2 Report submission (https://github.com/Intel-sense/upskillcampus/blob/42c9c1e7b6889c47644b1c7b84a285a48c12258d/SmartFarm_Abhilash_LN_USC_UCT.pdf)

4 Proposed Design/ Model

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4.1 High Level Diagram

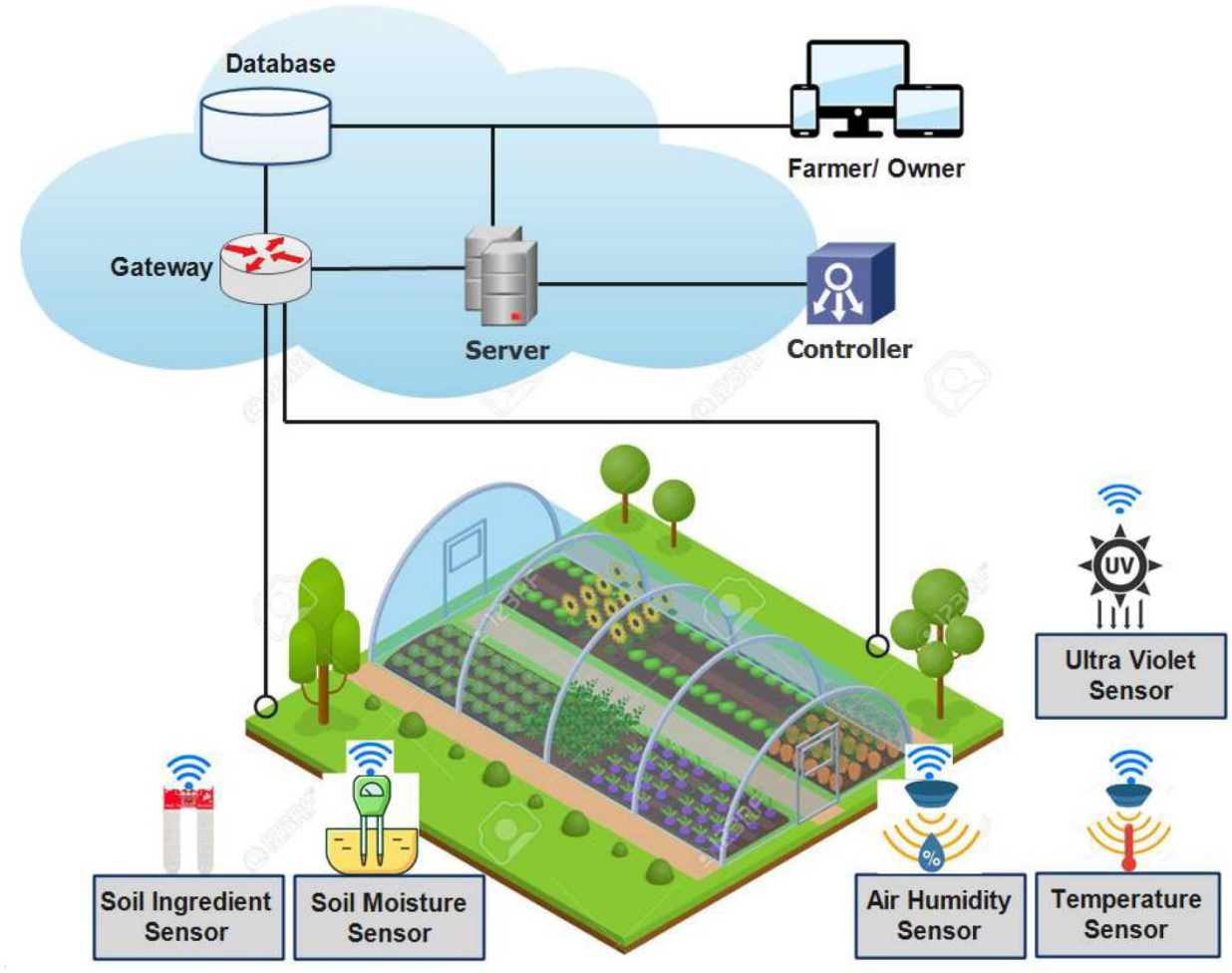
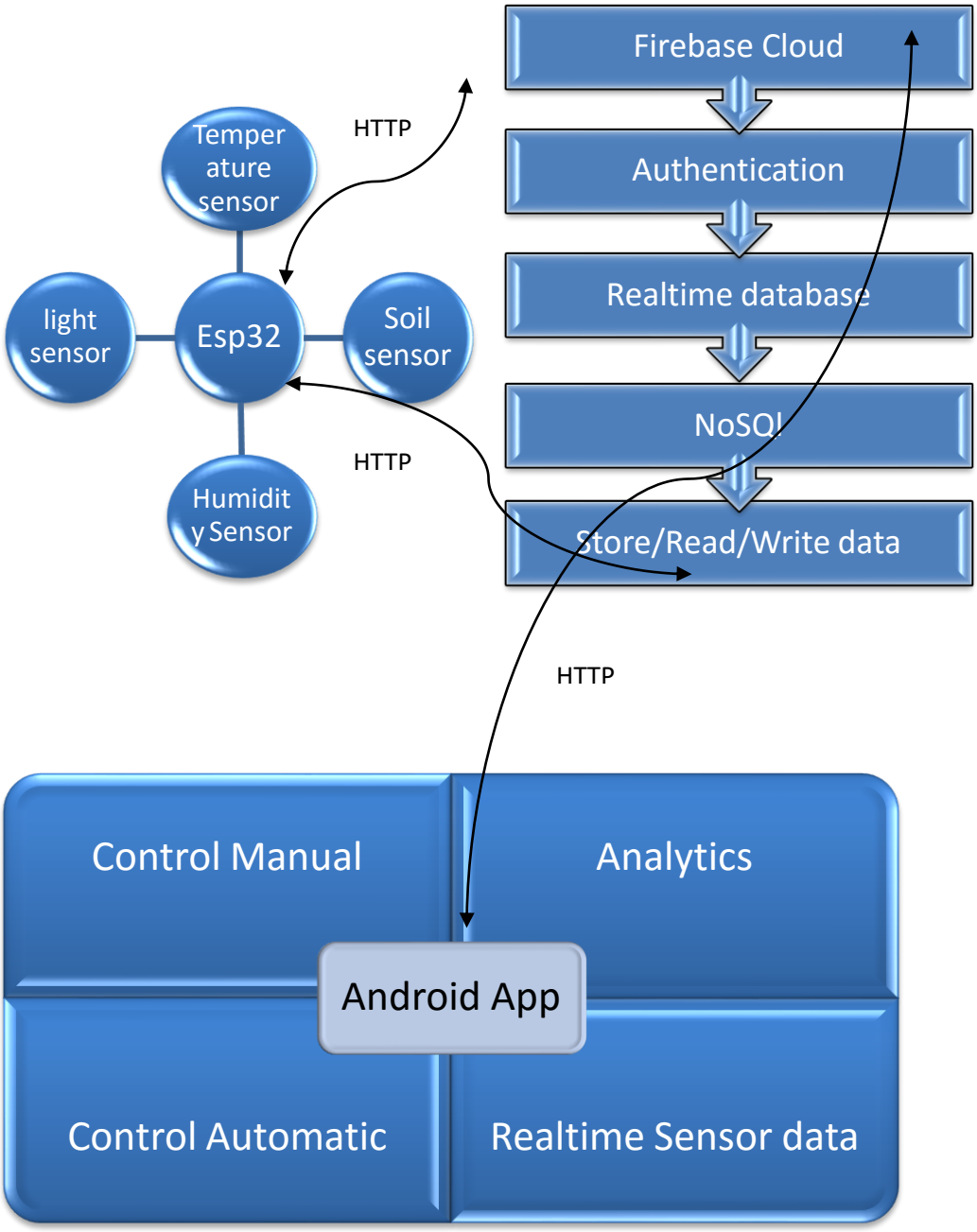
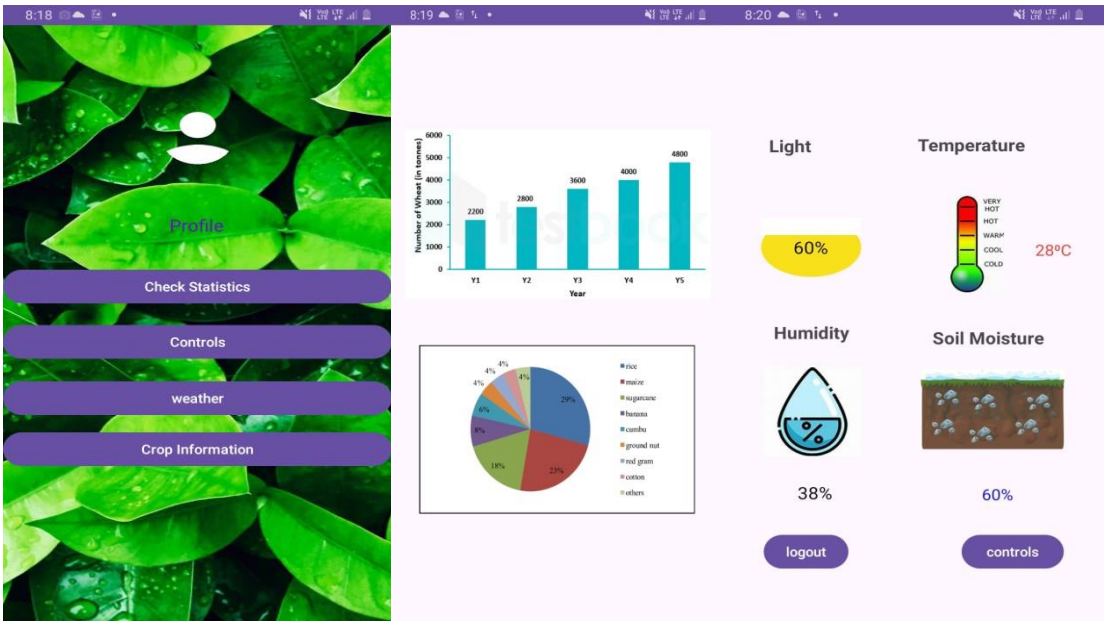


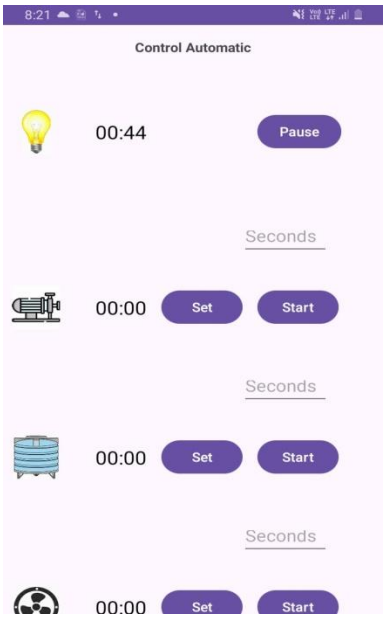
Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

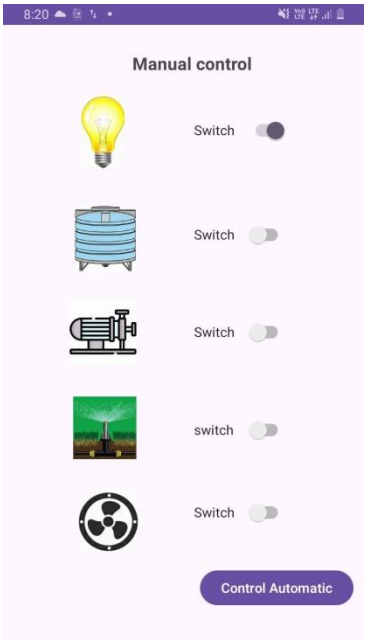
4.2 Low Level Diagram

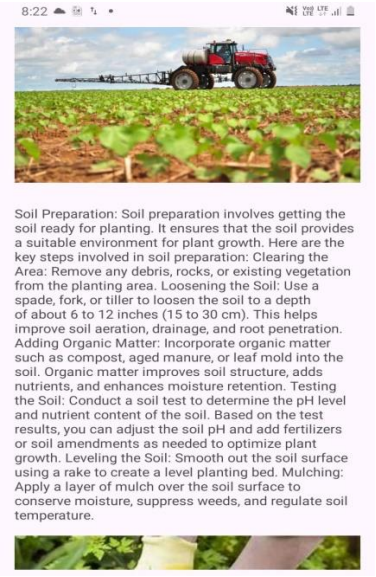


4.3 Interfaces









Soil Preparation: Soil preparation involves getting the soil ready for planting. It ensures that the soil provides a suitable environment for plant growth. Here are the key steps involved in soil preparation: Clearing the Area: Remove any debris, rocks, or existing vegetation from the planting area. Loosening the Soil: Use a spade, fork, or tiller to loosen the soil to a depth of about 6 to 12 inches (15 to 30 cm). This helps improve soil aeration, drainage, and root penetration. Adding Organic Matter: Incorporate organic matter such as compost, aged manure, or leaf mold into the soil. Organic matter improves soil structure, adds nutrients, and enhances moisture retention. Testing the Soil: Conduct a soil test to determine the pH level and nutrient content of the soil. Based on the test results, you can adjust the soil pH and add fertilizers or soil amendments as needed to optimize plant growth. Leveling the Soil: Smooth out the soil surface using a rake to create a level planting bed. Mulching: Apply a layer of mulch over the soil surface to conserve moisture, suppress weeds, and regulate soil temperature.

1. Rice:Growing Tips: Sowing: Rice is usually sown directly into flooded paddy fields or in seedbeds, then transplanted into the fields after 25-40 days. Water Management: Maintain flooded conditions in the field until the panicle initiation stage, then drain the water. Keep the field adequately irrigated during the growing season. Fertilization: Apply nitrogenous fertilizers in split doses at different growth stages. Weed Control: Keep the field weed-free by manual weeding or using herbicides.

Wheat Growing Tips: Sowing: Wheat is sown in well-prepared seedbeds at the onset of the winter season. Fertilization: Apply balanced doses of fertilizers containing nitrogen, phosphorus, and potassium. Water Management: Irrigate the field at critical growth stages such as crown root initiation, jointing, flowering, and grain filling. Weed Control: Keep the field weed-free through manual weeding or using

5 Performance Test

6.1 Test Plan/Test Cases:

- Memory Usage: Measure the memory footprint of the application, including RAM and storage usage, under various conditions such as normal operation and peak usage.
- Processing Speed: Evaluate the speed of data processing and analysis, including sensor data collection, transmission, and insights generation.
- Accuracy of Data: Assess the accuracy of sensor readings and data analysis algorithms compared to ground truth measurements.
- Durability and Reliability: Test the system's ability to withstand prolonged operation in harsh environmental conditions, including temperature extremes and moisture exposure.
- Power Consumption: Measure the power consumption of the IoT devices and the overall system to ensure efficiency and optimize battery life.

6.2 Test Procedure:

- Memory Usage: Monitor memory usage using system monitoring tools or profiling software while the application is running under different scenarios.
- Processing Speed: Benchmark data processing and analysis tasks by measuring the time taken to complete operations such as data collection, transmission, and analysis.
- Accuracy of Data: Compare sensor readings and analysis results against known values obtained from calibrated sensors or manual measurements.
- Durability and Reliability: Subject the system to stress tests, including extended operation in simulated harsh environments and exposure to extreme conditions.
- Power Consumption: Measure the power consumption of the IoT devices using specialized equipment or built-in power monitoring features.

6.3 Performance Outcome:

- Memory Usage: Ensure that memory usage remains within acceptable limits to prevent performance degradation or system crashes.
- Processing Speed: Aim for fast and efficient data processing to provide real-time insights to users and minimize latency.

- Accuracy of Data: Validate the accuracy of sensor readings and analysis algorithms to ensure reliable decision-making by farmers.
- Durability and Reliability: Confirm that the system can withstand environmental challenges and continue functioning reliably over extended periods.
- Power Consumption: Optimize power consumption to prolong battery life and reduce the need for frequent maintenance or battery replacement.

In cases where constraints were not directly tested, it is important to consider their potential impact on the design and implementation of the system. For example, high memory usage could lead to sluggish performance or even system crashes, particularly on resource-constrained IoT devices. To mitigate this, optimizing code efficiency and minimizing unnecessary data storage can help conserve memory resources. Similarly, excessive power consumption can shorten battery life and increase operational costs. Implementing power-saving techniques such as sleep modes for IoT devices and optimizing data transmission protocols can help reduce power consumption and extend battery life.

6 My learnings

Summary of Overall Learning and Career Growth:

Throughout the project, I gained valuable insights and experiences that significantly contributed to my professional development. Here's a summary of my key learnings and how they will impact my career growth:

1. **Technical Skills Enhancement:**
    - Developed proficiency in various technologies and tools such as Android Studio, Java programming, IoT devices, MQTT protocol, and cloud-based platforms like Firebase.
    - Acquired hands-on experience in full-stack app development, including frontend design, backend development, and database management.
    - Explored integration of IoT devices with mobile applications, understanding the complexities involved in real-time data collection and analysis.
2. **Problem-Solving and Troubleshooting:**
    - Faced and resolved numerous challenges throughout the project, including connectivity issues, debugging errors, and integration complexities.
    - Enhanced my ability to systematically approach problems, identify root causes, and implement effective solutions.
    - Developed resilience and adaptability in overcoming technical hurdles and navigating unforeseen obstacles.
3. **Understanding of Industry Applications:**
    - Explored real-world applications of technology in agriculture, recognizing the potential for IoT solutions to address industry challenges.
    - Gained insights into the importance of technology in driving innovation and sustainability across various sectors.
    - Developed a deeper understanding of the role of technology in solving complex problems and improving processes.
4. **Continuous Learning and Growth Mindset:**

- Embraced a mindset of continuous learning, seeking out new challenges and opportunities for skill development.
- Recognized the importance of staying updated with emerging technologies and industry trends to remain competitive in the job market.
- Committed to ongoing self-improvement and professional growth, leveraging experiences from this project to fuel future endeavors.

Overall, the project provided a valuable learning experience that not only enhanced my technical skills but also equipped me with essential soft skills and a growth mindset necessary for success in my career. I am confident that the knowledge and experiences gained will serve as a solid foundation for tackling future challenges and pursuing further career advancement opportunities in the field of technology and beyond.

7 Future work scope

Ideas for Future Development:

1. Integration of Machine Learning Algorithms: Implement machine learning algorithms to analyze sensor data and provide predictive insights for farmers. This could include predicting crop yields, identifying optimal planting times, or detecting potential pest infestations.
2. Enhanced User Interface: Further improve the user interface of the mobile application to provide a more intuitive and engaging experience for farmers. This could involve incorporating interactive data visualizations, customizable dashboards, and personalized recommendations.
3. Expansion of Sensor Capabilities: Explore additional sensor technologies to expand the range of data collected from the field. For example, integrating sensors for monitoring air quality, pest presence, or crop health could provide farmers with more comprehensive insights into their operations.
4. IoT Device Optimization: Optimize the design and functionality of IoT devices to improve performance, reliability, and energy efficiency. This could involve reducing device size and power consumption, enhancing connectivity options, and implementing advanced sensor calibration techniques.
5. Cloud-Based Analytics and Reporting: Develop advanced analytics and reporting features within the cloud-based backend to enable deeper insights and actionable recommendations for farmers. This could include trend analysis, anomaly detection, and automated report generation based on historical data.
6. Integration with Agricultural APIs: Integrate with third-party agricultural APIs to access additional data sources and services that could complement the existing functionality of the application. This could include weather forecasting APIs, crop price databases, or soil quality analysis services.
7. IoT Network Expansion: Expand the IoT network infrastructure to cover larger geographical areas and support more farms and agricultural operations. This could involve deploying additional IoT devices, implementing mesh networking technologies, and optimizing communication protocols for scalability and reliability.