Project Report

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Team ID:- PNT2025TMIID06956

1. INTRODUCTION

1.1 Project Overview

The project aims to develop a system for predicting the growth stages of plants based on environmental factors (such as temperature, humidity, and soil conditions) and management practices (such as irrigation, fertilization, and pest control). This prediction model is built using Power BI, leveraging its powerful data visualization capabilities and integration with advanced analytics tools like R and Python. The system will help farmers, agricultural researchers, and decision-makers optimize agricultural practices to improve crop yield and ensure more efficient resource management.

1.2 Purpose

The purpose of this project is to develop a data-driven solution that predicts plant growth stages based on environmental and management data using Power BI. This project aims to provide agricultural professionals, researchers, and decision-makers with the tools to optimize crop yield, improve resource management, and enhance overall agricultural productivity. By leveraging the power of machine learning models and advanced data visualization, the project intends to:

1. **Enhance Agricultural Efficiency**: Provide insights that help optimize the use of resources like water, fertilizers, and pesticides, leading to more sustainable farming practices.
2. **Improve Crop Yield**: By accurately predicting plant growth stages and understanding environmental factors, farmers can make informed decisions that enhance crop health and maximize yield.
3. **Facilitate Data-Driven Decision-Making**: The project empowers agricultural stakeholders with real-time data and predictive insights, allowing them to make informed decisions based on environmental conditions, management practices, and predicted growth trends.
4. **Optimize Management Practices**: Enable farmers to fine-tune their irrigation schedules, fertilization plans, and other management practices according to the predicted growth stages of plants, improving productivity and reducing waste.
5. **Bridge the Gap Between Data and Action**: By integrating machine learning into Power BI’s user- friendly interface, the project makes complex data analysis and growth predictions accessible to non-technical users in the agricultural sector.

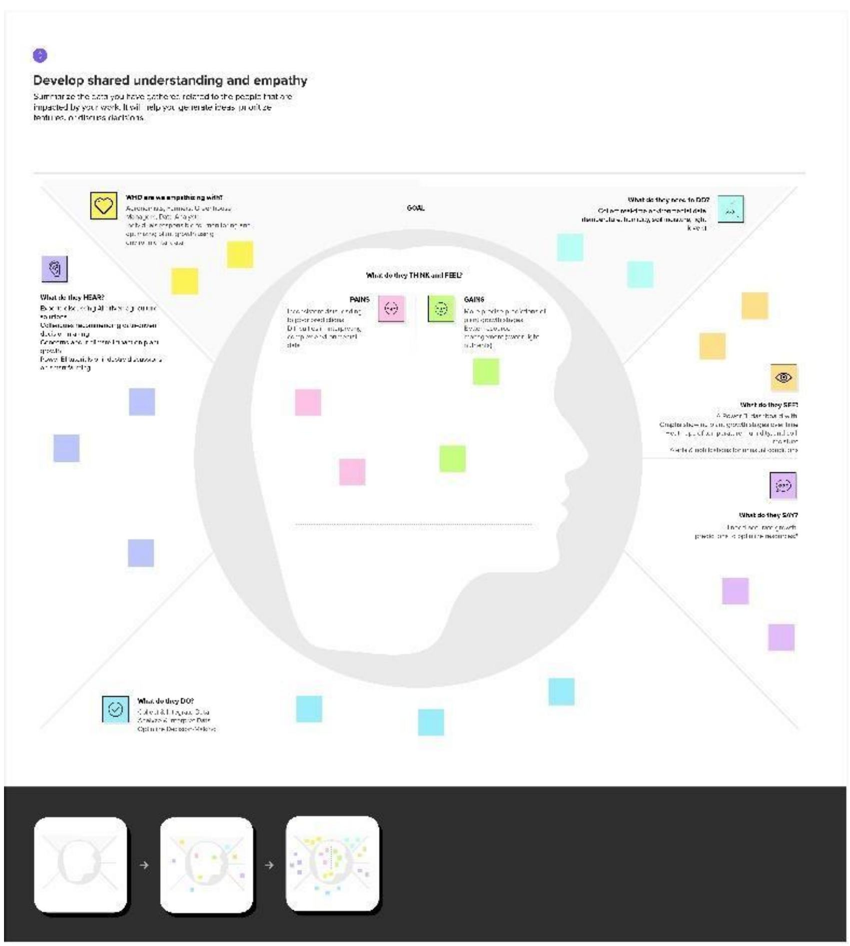
In essence, the project's purpose is to create a tool that helps bridge the gap between environmental data, management practices, and plant growth, thereby fostering smarter, data-driven agricultural practices.

2. IDEATION PHASE

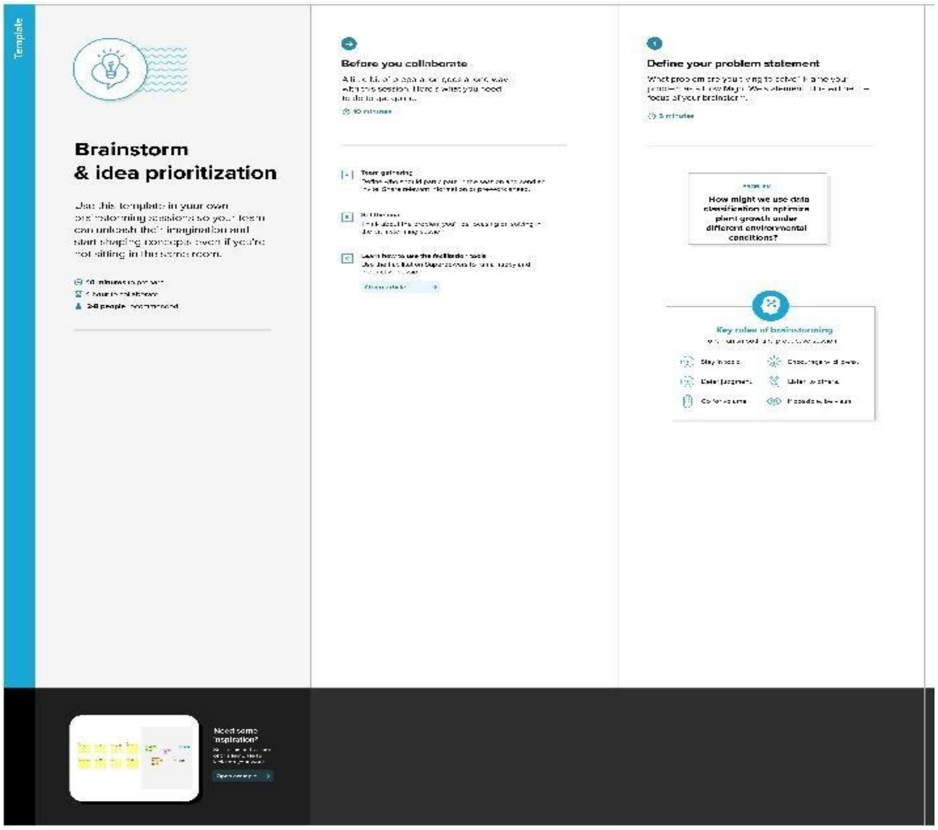
2.1 Problem Statement

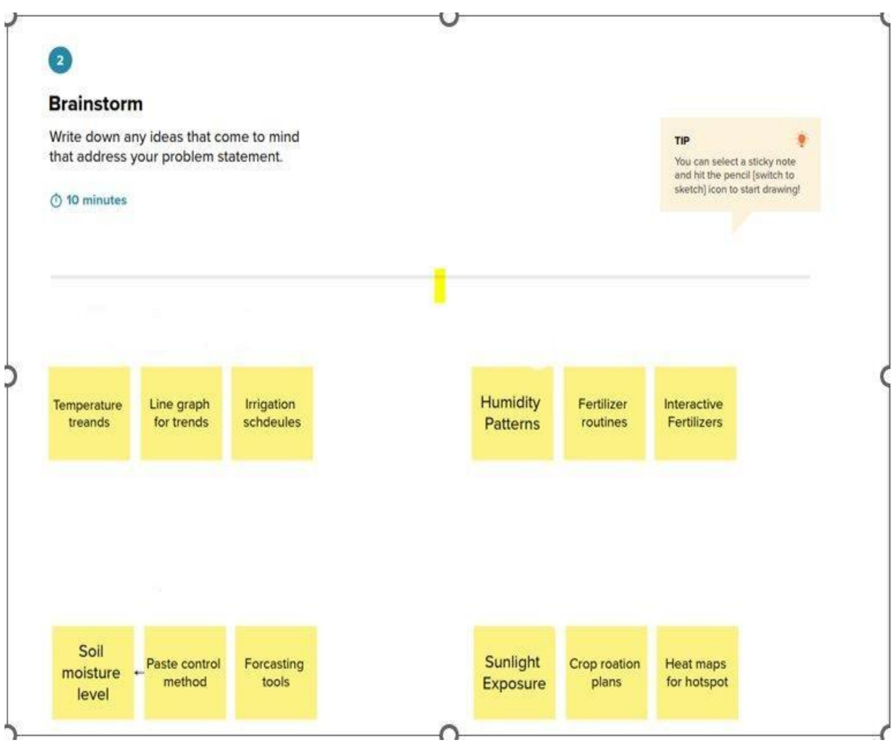
In modern agriculture, predicting plant growth stages accurately is a complex challenge that requires considering various environmental factors (such as temperature, soil moisture, and humidity) and management practices (like irrigation, fertilization, and pest control). Traditional methods of assessing plant growth rely heavily on manual observation and experience, which can be time-consuming, inconsistent, and prone to errors. Additionally, these methods often fail to leverage the full potential of available environmental and management data, leading to inefficiencies in resource use and suboptimal crop yields.

2.2 Empathy Map Canvas



2.2 **Brainstorming**





Cluster 1: Environmental Data

- Temperature trends
- Humidity patterns
- Rainfall data
- Sunlight exposure
- Soil moisture levels

Cluster 2: Management Data

- Irrigation schedules
- Fertilizer routines
- est control strategies
- Crop rotation plans
- Harvest timing

Cluster 3: Power BI Features

- Line graphs for visualizing growth trends
- Interactive filters for comparison
- Forecasting tools for future growth stages
- KPI indicators for crop health insights
- Heat maps for environmental influence

Group of Similar Clusters

- Environmental impact on crop yield
- Reducing crop wastage through prediction
- Top-performing crop regions based on data
- Effects of climate change on plant growth

4

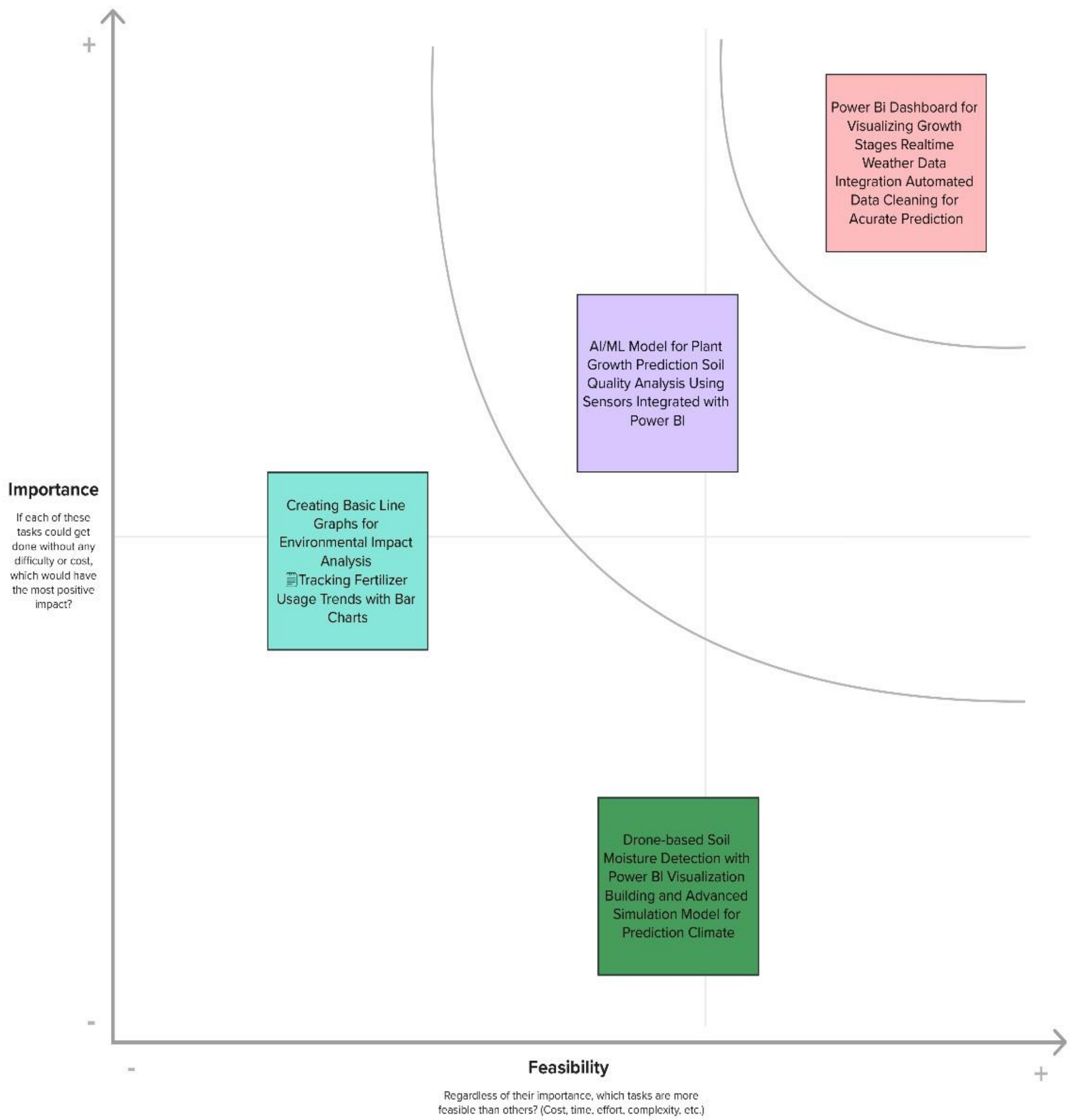
Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

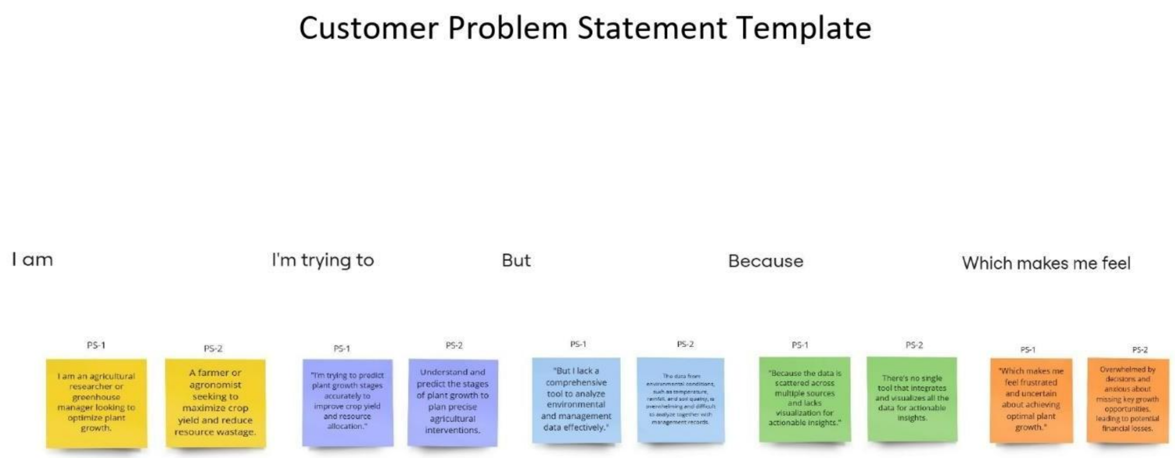
TIP

Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the **H key** on the keyboard.



3 REQUIREMENT ANALYSIS

3.1 Customer Journey map



Solution Requirement

Functional Requirements

Following are the functional requirements of the proposed solution.

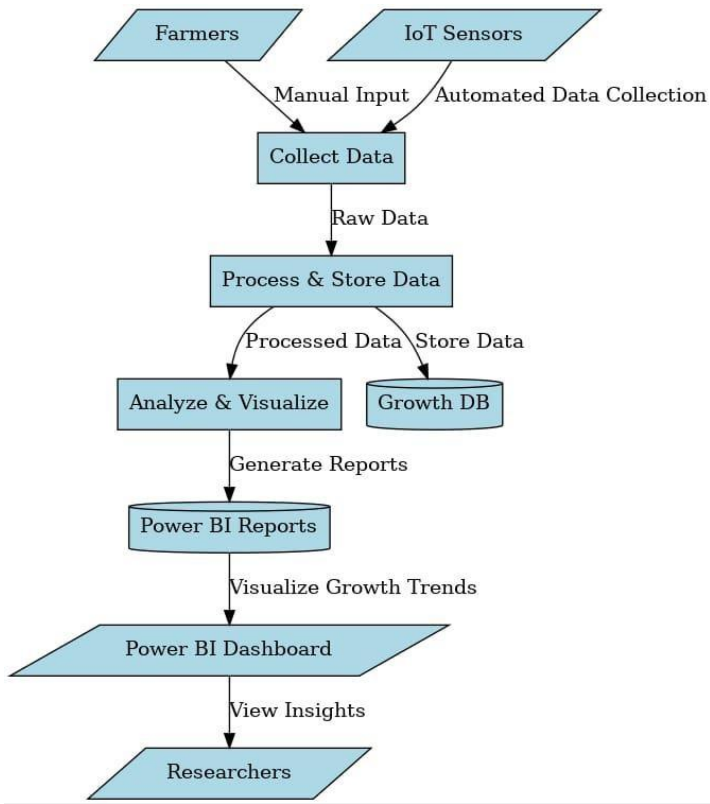
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Data Integration	Import Environmental Data Import Management Data Data Cleaning and Transformation

FR-4	Data Visualization	Create Dashboards in Power BI Display Trends and Correlations Generate Customized Reports
FR-5	Prediction System	Develop Machine Learning Models Predict Plant Growth Stages Recommendations

Non-Functional Requirements

NFR No.	**Non-Functional Requirement**	**Description**
NFR-1	Usability	The solution must have an intuitive and user-friendly interface.
NFR-2	Security	Ensure secure data storage and user authentication.
NFR-3	Reliability	The system should be highly dependable and provide accurate predictions.
NFR-4	Performance	Maintain fast processing and data visualization even with large datasets.

3.2 **Data Flow Diagram**



3.4 Technology Stack

Table 1: Application Components

S.No	**Component**	**Description**	**Technology**
1	User Interface	User interfaces like Web UI or Mobile Apps to interact with the Power BI dashboards	HTML, CSS, JavaScript, ReactJS
2	Application Logic-1	Data ingestion logic to extract environmental and management data from various sources	Python
3	Application Logic-2	Speech-to-text logic for audio input (e.g.,	IBM Watson STT

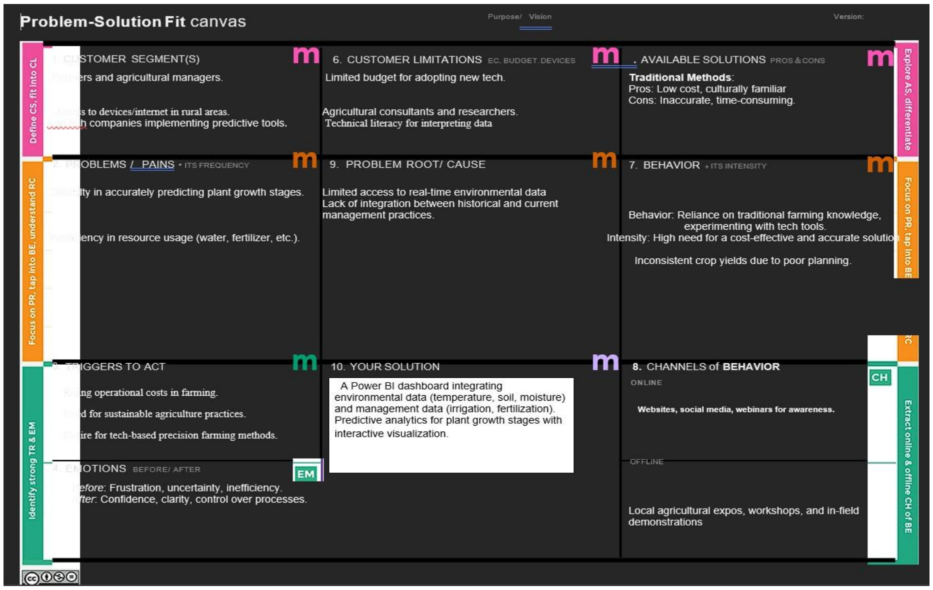
		voice commands for querying plant growth stages)	service
4	Application Logic-3	Virtual assistant to answer user queries related to plant growth predictions	IBM Watson Assistant
5	Database	Stores raw and transformed data, including historical plant growth and environmental factors	MySQL, NoSQL
6	Cloud Database	Centralized storage of large-scale data for scalability	IBM Cloudant
7	File Storage	Storage for large environmental datasets and model output	IBM Block Storage or Cloud-based storage
8	External API-1	Provides real-time environmental data (e.g., weather conditions)	IBM Weather API
9	External API-2	Identity verification for restricted access (if required)	Aadhar API
10	Machine Learning Model	Predicts plant growth stages based on input data	Custom ML Model (developed in Python)
11	Infrastructure (Server/Cloud)	Deployment of application on a cloud platform for scalability and availability	Kubernetes on IBM Cloud

Table 2: Application Characteristics

S.No	Characteristics	Description	Technology
1	Open-Source Frameworks	Frameworks to build the application frontend or backend	ReactJS, Flask, Django
2	Security Implementations	Implements access controls, encryptions, and secure API calls	SHA-256, IAM Controls, OWASP Guidelines
3	Scalable Architecture	Designed as microservices or a 3-tier architecture for scaling	Kubernetes, Docker
4	Availability	Load balancers and distributed servers ensure consistent access	Load Balancers, Distributed Cloud Servers
5	Performance	Performance optimization using caching and CDNs	CDN, Redis Cache

4 PROJECT DESIGN

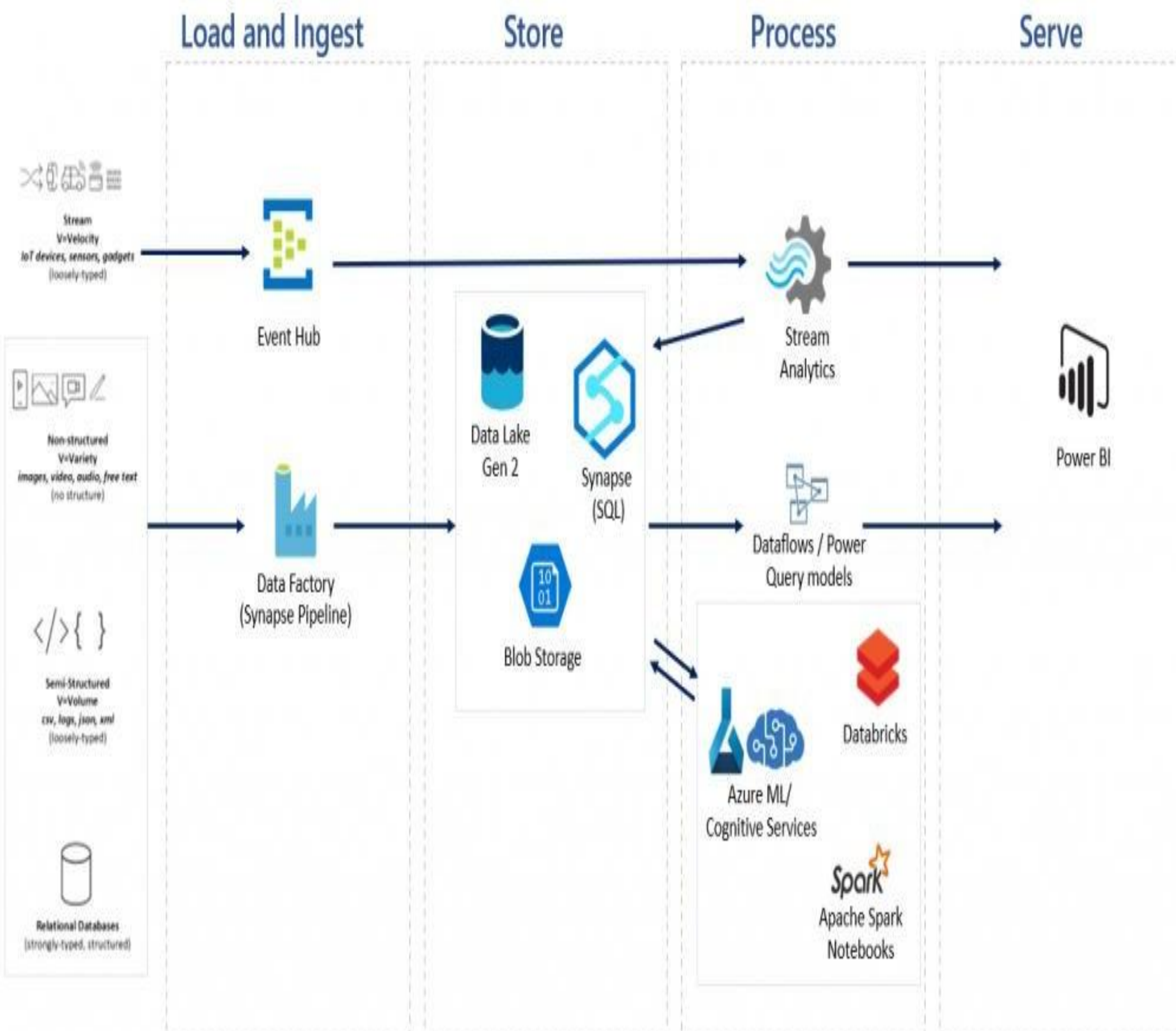
4.1 Problem Solution Fit



4.2 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement	Clearly define the problem that the solution aims to solve.
2.	Idea / Solution Description	Provide a detailed explanation of the proposed idea or solution.
3.	Novelty / Uniqueness	Highlight the innovative aspects or unique features of the solution.
4.	Social Impact / Customer Satisfaction	Explain how the solution benefits society or improves customer experience.
5.	Business Model (Revenue Model)	Describe the financial sustainability of the solution, including how revenue is generated.
6.	Scalability of the Solution	Outline the potential for scaling the solution to reach larger markets or audiences.

4.3 Solution Architecture



5. PROJECT PLANNING & SCHEDULING

Project Planning

Product Backlog and Sprint Schedule:

Sprint	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task Description**	**Story Points**	**Priority**	**Team Members**
Sprint- 1	Data Collection and Integration	USN-1	Gather relevant environmental data, including temperature, Humidity, soil moisture and light levels	7	High	Balaji
	Data Preparation	USN-2	Cleans the collected data for analysis	8	High	Balaji, JayaRaghavendra
Sprint- 2	Data analysis and Modeling	USN-3	Utilize Power BI.s analytical tools to explore relationships between environmental factors and Plants growth stages	5	Low	Jaya Raghavendra, Shaje
	Visualization Development	USN-4	Create interactive visualization for key metrics	8	Medium	Shaje, PushpaRaju
	Dashboard Design	USN-5	Design user-Friendly interfaces that allow stakeholders to easily access and interpret data	8	High	Balaji, PushpaRaju

Project Tracker and Velocity:

Sprint	Total Story Points	Duration (Days)	Start Date	End Date (Planned)	Story Points Completed (Planned)	Release Date (Actual)
Sprint- 1	24	5	13 Mar 2025	17 Mar 2025	24	26 Mar 2025
Sprint- 2	24	5	17 Mar 2025	21 Mar 2025	24	26 Mar 2025

Velocity Calculation

Velocity = Total Story Points / Total Sprint Duration (in days).

If the team's average velocity is 20 points per sprint (10-day sprint duration), Average Velocity (AV) = 2 story points per day.

Burndown Chart

A burndown chart illustrates:

X-axis: Sprint duration (time in days).

Y-axis: Remaining story points.

It starts with 20 story points at day 0 and decreases daily based on completed points.

6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing

Performance testing evaluates how the system performs under expected and peak loads. The following aspects are tested:

- **Load Testing** – Determines how the system handles multiple users accessing the dashboard simultaneously.
- **Stress Testing** – Assesses system behavior under extreme conditions, such as high data input or network lag.
- **Scalability Testing** – Ensures the system can efficiently handle increasing amounts of data and user interactions.
- **Response Time Analysis** – Measures the time taken to process and display reports in Power BI.
- **Data Processing Speed** – Evaluates how quickly large datasets are imported, cleaned, and visualized.

System Resource Utilization – Monitors CPU, memory, and network usage during peak operations

7. RESULTS

7.1 Screenshots of Report and observation

7.2 Screenshot of Dashboard and observation


Predicting Plant Growth Stages with Environmental and Management Data
58
Average of Humidity
31
Sum of Growth_Milestone
64
Count of Sunlight_Ho...
34.01
Max of Temperature
Count of Temperature and Count of Growth_Milestone by Soil_Type
Soil_Type sandy
Count of Soil_Type
64 (100%)
Soil_Type
sandy
Sum of Growth_Milestone by Soil_Type
sandy
Sum of Growth_Milestone by Sunlight_Hours and Soil_Type
Soil_Type sandy
clay
loam
sandy
Sum of Growth_Milestone by Soil_Type and Fertilizer_Type
Fertilizer_Type chemical none organic
sandy


Predicting Plant Growth Stages with Environmental and Management Data
58
Average of Humidity
31
Sum of Growth_Milestone
64
Count of Sunlight_Ho...
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Max of Temperature
Count of Temperature and Count of Growth_Milestone by Soil_Type
Soil_Type sandy
Count of Soil_Type
64 (100%)
Soil_Type
sandy
Sum of Growth_Milestone by Soil_Type
sandy
Sum of Growth_Milestone by Sunlight_Hours and Soil_Type
Soil_Type sandy
clay
loam
sandy
Sum of Growth_Milestone by Soil_Type and Fertilizer_Type
Fertilizer_Type chemical none organic
sandy

8. ADVANTAGES & DISADVANTAGES

Advantages

1. Provides data-driven insights for better decision-making.
2. Increases productivity and optimizes resource use.
3. Scalable and user-friendly with Power BI’s visualizations.
4. Real-time environmental adaptation improves outcomes.

Disadvantages

1. High initial cost and technical expertise required.
2. Depends heavily on data quality for accuracy.
3. Accessibility challenges in remote areas.
4. Requires ongoing maintenance and retraining.

9. CONCLUSION

The project successfully demonstrates the ability to predict plant growth stages using environmental and management data. The integration of machine learning models with Power BI provides farmers with actionable insights, which can improve resource utilization, crop yield, and overall farm productivity. The solution is scalable, and with continuous data collection, predictions will improve over time.

10. FUTURE SCOPE

Integration with IoT Devices: Real-time integration with environmental sensors can enhance prediction accuracy.

- Advanced Analytics: The system can be extended to provide more advanced analytics, like pest and disease prediction.
- Multi-Crop Support: Expand the model to predict growth stages for various crops.