

Digital Twin Development Plan

Digital Twin for Plant Health Monitoring

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September 18, 2025

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Project Objectives

- ▶ Build a **fully autonomous digital twin** for plant health monitoring
- ▶ Implement **advanced analytics** and machine learning models
- ▶ Create **feedback loops** for automated control
- ▶ Develop comprehensive **data preprocessing** capabilities
- ▶ Establish **real-time monitoring** and prediction systems

Most Critical Tasks for Core Functionality

1. Data Preprocessing & Quality Assurance

- ▶ Real-time validation and anomaly detection
- ▶ Missing data handling and normalization

2. Core Data Pipeline & Storage

- ▶ Real-time streaming (Kafka/Spark)
- ▶ Time-series database optimization

3. Basic ML Models for Health Classification

- ▶ Plant health status classification
- ▶ Simple prediction models

Critical Tasks (Continued)

4. Minimal Viable Feedback Loop

- ▶ Basic automated responses (irrigation, alerts)
- ▶ Manual override capabilities

5. Core User Interface & Monitoring

- ▶ Real-time sensor visualization
- ▶ Health status display
- ▶ System alerts and control interface

Phase 1: Data Preprocessing Module (Months 1-3)

Objectives:

- ▶ Establish robust data preprocessing pipeline
- ▶ Handle anomalies and missing data
- ▶ Handle multivariate DB (1 for time series data, 1 for historical data (logs, ...))

Phase 2: Feedback Loop & Control (Months 3-6)

Objectives:

- ▶ Implement closed-loop control
- ▶ Enable autonomous decision making

Phase 3: Advanced Analytics & ML (Months 6-10)

Objectives:

- ▶ Model Registry setup
- ▶ Health classification models
- ▶ Prediction algorithms
- ▶ Pipeline for models
- ▶ Discriminate between OFFLINE and ONLINE (how both will coexist)

Phase 4: Enhanced UI

Objectives:

- ▶ Develop modern user interface
- ▶ Integrate computer vision

Development Timeline

