Digital Twin Development Plan

Digital Twin for Plant Health Monitoring

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Project Objectives

Build and validate a working digital twin that monitors a plant and acts safely to keep it healthy, with a clear dashboard and basic prediction

- One plant, one Raspberry Pi, a few sensors + controlled actuators (pump/light/fan/resistor).
- Clean data, clear alerts, simple rules for actions, first predictive model

Current Status

- Raspberry Pi + sensors connected and reading
- Flask dashboard and REST endpoints
- Data stored with basic structure (influxDB)
- Working Kafka broker setup

P1: Data Quality & Non-Time-Series Logs (Oct-Dec)

Objectives:

- Establish robust **data preprocessing pipeline**
  - Handle short gaps and flag longer gaps.
  - catch spikes and bad values
- Simple **alerts** "Soil too dry for 15 min $\rightarrow$ suggest watering."
- Additionally to the TS DB, **setup a RDB** to handle logs of actions, history of alerts, etc...
- "**Summarize**" long-range data daily/weekly

Phase 2: Feedback Loop & Control (Feb-Mar)

Objectives:

- **Manual controls** in the dashboard (pump/light/fan/resistor)
- Introduce **automatic rules** (autonomous decision making)
  - Soil Moisture Rules: Water pump activation based on treshold for a specific amount
  - Photoperiod schedule: Ensure specifc amount of light per day
  - Temperature / Humidity Rules: Control fan and resistor to keep an optimal environment for plant growth
  - ...
- **Write the documentation** for following students

Phase 3: Basic Predictions & Health Score (Apr-June)

Objectives:

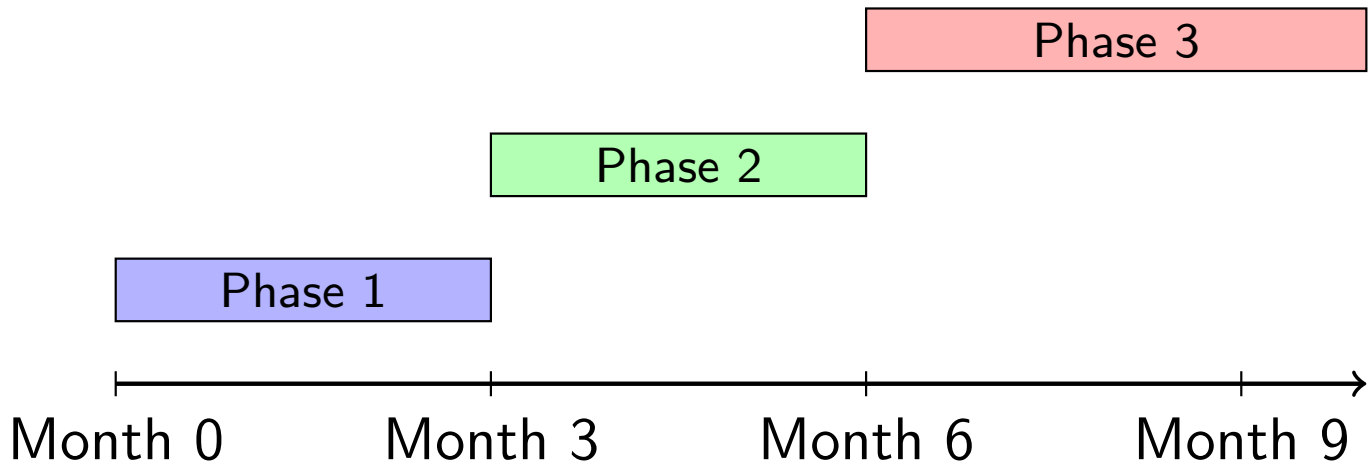
- Way to manage different models (OFFLINE and ONLINE), their pipeline -learning, prod, archives- (**Model Registry like**)
- A simple **next-day moisture forecast**.
- If enough time: 3-level health label: healthy ok needs attention

Parallel work: Enhanced UI

Objectives:

- Clean, simple dashboard
- Alert center to review and acknowledge notifications
- Camera capture placeholder for future work

Development Timeline



Final Deliverables

- **Working setup**: Pi + sensors + actuators.
- **Dashboard**: Live data, alerts, manual controls, activity log
- **Documentation**: setup guide, wiring diagram