User Requirements Specification (URS)

NanoRiego

1. Statement of Purpose

This document articulates the User Requirements Specification (URS) for the NanoRiego intelligent irrigation platform. It establishes a comprehensive delineation of the system's functional, non-functional, and interfacing imperatives from the perspective of end-user interactions. The URS serves as a formalized artifact to underpin subsequent system architecture, engineering, implementation, verification, and validation activities across the development lifecycle.

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2. System Scope

NanoRiego is conceived as a low-cost, modular, and scalable embedded system designed to manage localized irrigation networks with precision. It comprises three synergistic subsystems: (1) the NanoRiegoPCB hardware control board, (2) the NanoRiegoPIO embedded firmware governing system logic, and (3) the NanoRiegoAPP Android application which facilitates remote user interaction and real-time configuration. The primary operational domain for NanoRiego is within domestic horticultural environments or educational demonstration installations.

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3. User-Centered Requirements

3.1 Functional Requirements

- **UR1**: The system shall support actuation of up to three (3) discrete irrigation valves.

- **UR2**: The system shall support activation and deactivation of a singular hydraulic pumping mechanism.

- **UR3**: End-users shall be enabled to initiate and terminate irrigation of any individual zone via manual override.

- **UR4**: The system shall facilitate temporal scheduling of irrigation events, with granularity in daily recurrence and zone-specific durations.

- **UR5**: Upon establishing a Bluetooth link, the system shall automatically synchronize its internal real-time clock with the host Android device.

- **UR6**: The system shall implement non-volatile data retention to preserve user-defined parameters and scheduling configurations across power cycles.

3.2 Non-Functional Requirements

- **UR7**: The system's constituent hardware modules shall be physically decoupled and replaceable to promote maintenance and upgradability.

- **UR8**: The aggregate bill of materials (BOM) shall remain within a predefined economic threshold, estimated between 19€ and 43€.

- **UR9**: System deployment shall not necessitate advanced technical expertise, and must comply with basic electrical installation safety standards.

- **UR10**: The mobile application shall provide intuitive and continuous visual feedback on Bluetooth connectivity status.

- **UR11**: Following initial manual pairing, the system shall attempt to auto-reconnect to the designated Android host on subsequent launches.

3.3 Interface Requirements

- **UR12**: The Android application shall afford users the capability to:

  - Configure system date and time.

  - Toggle irrigation zones on or off.

  - Define and modify per-zone irrigation schedules.

  - Manually trigger or suspend irrigation events.

- **UR13**: The HC-05 Bluetooth module shall utilize a standard PIN-based authentication procedure for initial pairing.

- **UR14**: In the absence of an active controller connection, the UI shall dynamically disable all functions requiring remote actuation or status polling.

4. Operational Assumptions and Systemic Constraints

- The intended context of use is constrained to small-scale or pilot irrigation systems.

- It is assumed that the user possesses baseline familiarity with Android OS navigation and app interaction.

- All electrical interfacing must conform to fundamental low-voltage safety protocols.

- The system architecture prescribes a static configuration of three irrigation zones and a single hydraulic pump; expansion or reconfiguration is outside current scope.

5. Approval Process

Formal approval and stakeholder endorsement are mandatory prerequisites to initiating any design modifications, feature expansions, or release cycles. Validation of compliance with user requirements shall be verified during final acceptance testing.

Additional user-driven scenarios, environmental tolerances, or deployment considerations may be integrated upon request to ensure completeness of this URS.