SEQAYA Summary

The invention provides a smart soil irrigation device, SEQAYA, featuring ultra-low-energy operation with expected battery longevity exceeding five years. SEQAYA comprises an ESP microcontroller, soil moisture sensor, latching solenoid valve, NFC communication unit, and a single multifunction button. At first use, SEQAYA operates with default moisture threshold and sampling frequency values. Users can later configure specific plant parameters via a smartphone app through NFC communication. Short pressing the device's button activates 'Locate Mode,' helping match the physical device to its digital representation in the app. Long pressing the button activates 'Plant Configuration Mode,' allowing reprogramming for a different plant. Energy-efficient techniques such as deep sleep modes, controlled sampling, and solid-state circuit drivers maximize power savings. Optionally, SEQAYA synchronizes soil and irrigation data to a cloud server for monitoring and future optimizations.

Claims:

1. An ultra-low-energy soil irrigation device comprising:

- an ESP microcontroller;
- a soil moisture sensor;
- a latching electric valve;
- a single multifunction physical button;
- an NFC communication unit;
- solid-state drivers for controlled activation of components;
- a battery power supply;
- wherein the device operates with preset default moisture thresholds and sampling rates until reconfigured.

2. The device of claim 1, wherein a short press of the physical button activates a Locate Mode allowing NFC communication to identify the device within a smartphone app.

3. The device of claim 1, wherein a long press of the physical button activates a Plant Configuration Mode allowing reprogramming of plant-specific irrigation parameters via NFC.

4. The device of claim 1, wherein the device enters a deep sleep or hibernation mode between scheduled operations to minimize power consumption.

5. The device of claim 1, wherein solid-state driver circuits selectively power the soil moisture sensor and NFC communication module only during active periods.

6. The device of claim 1, wherein a smartphone app provides an option for user-configurable soil moisture sampling frequency, with advisory information regarding effects on battery longevity.

7. The device of claim 1, optionally connecting to a cloud server to store moisture and irrigation data for analysis and optimization.

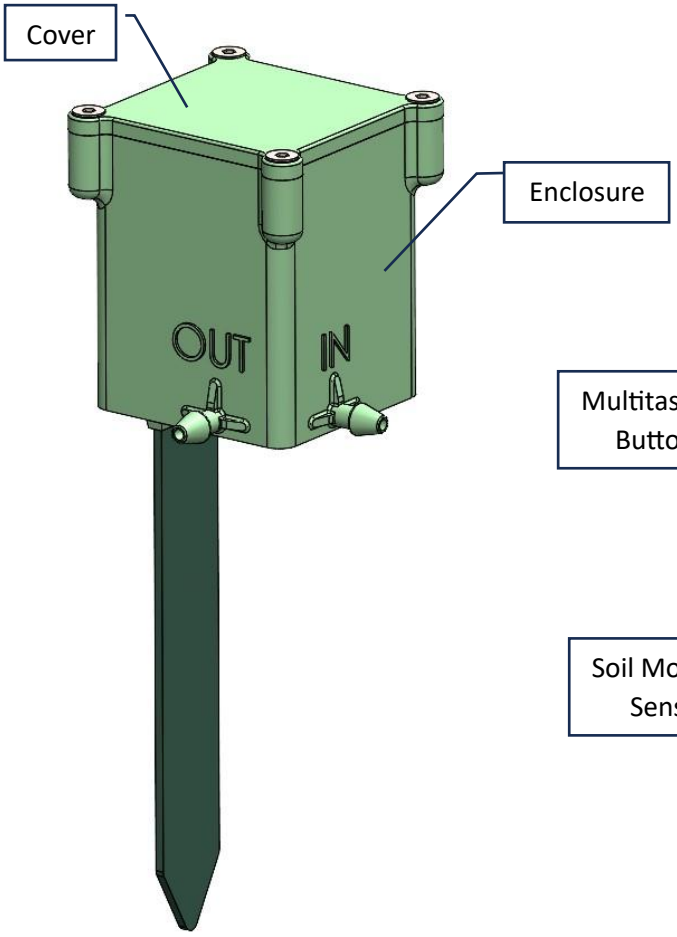


FIG. 1

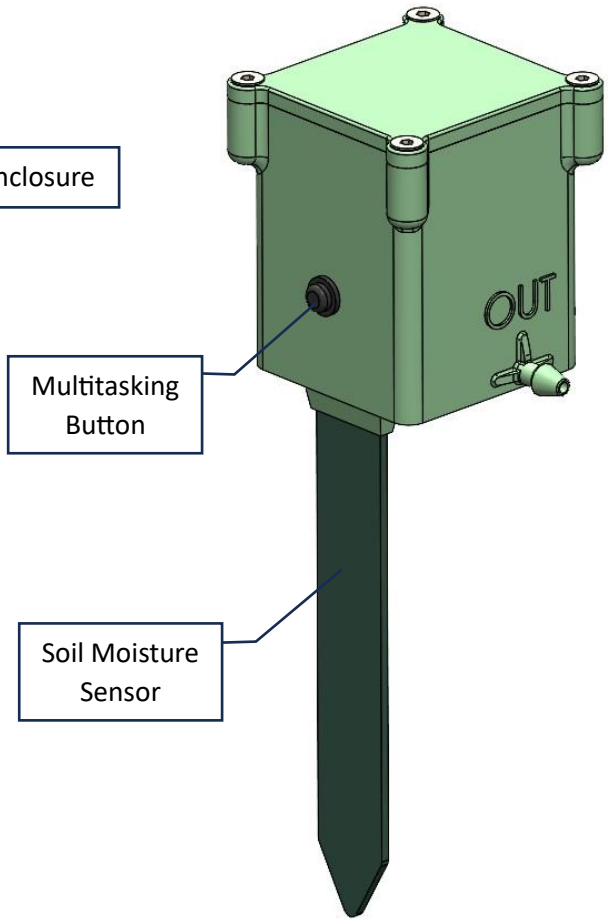
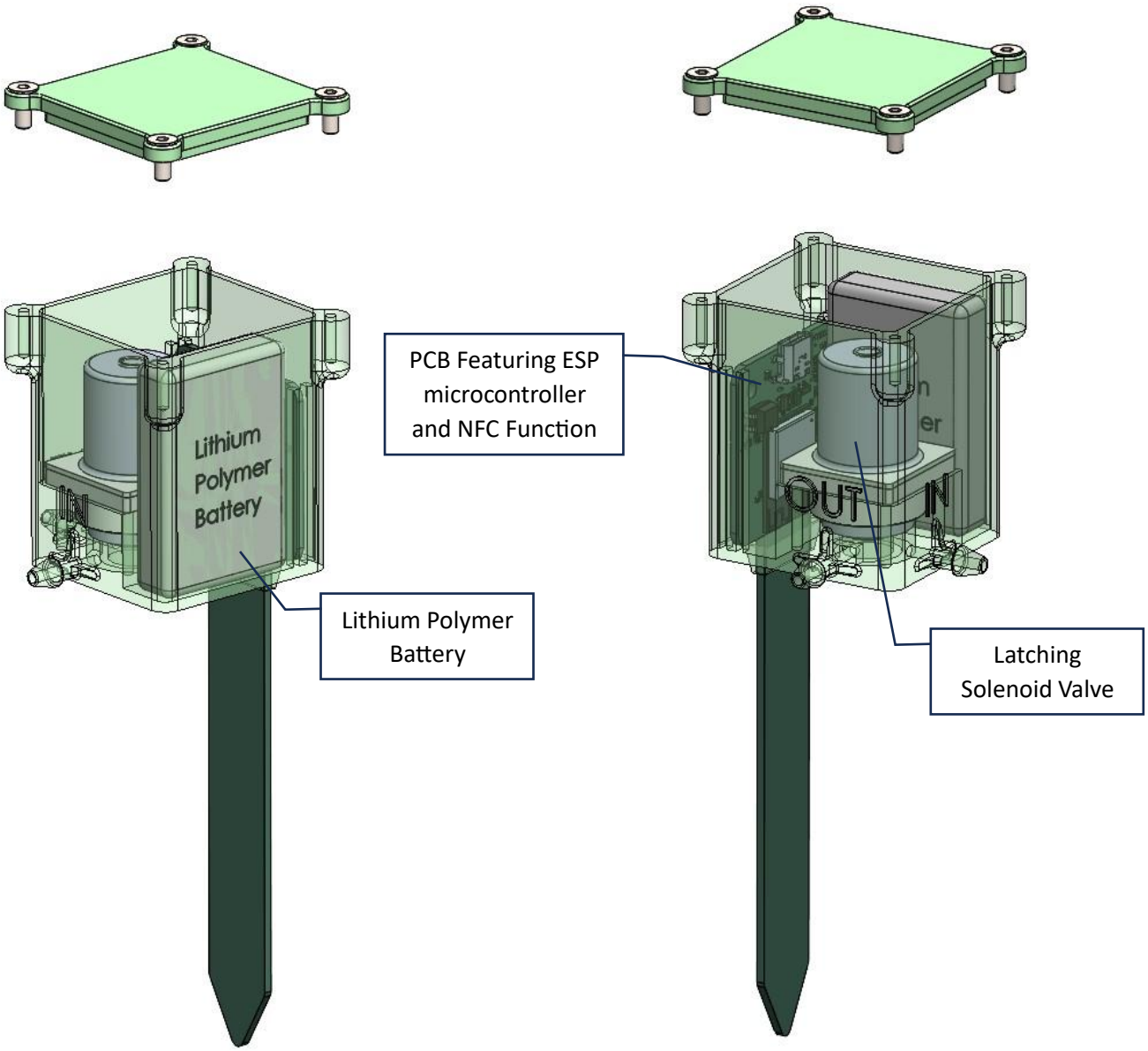
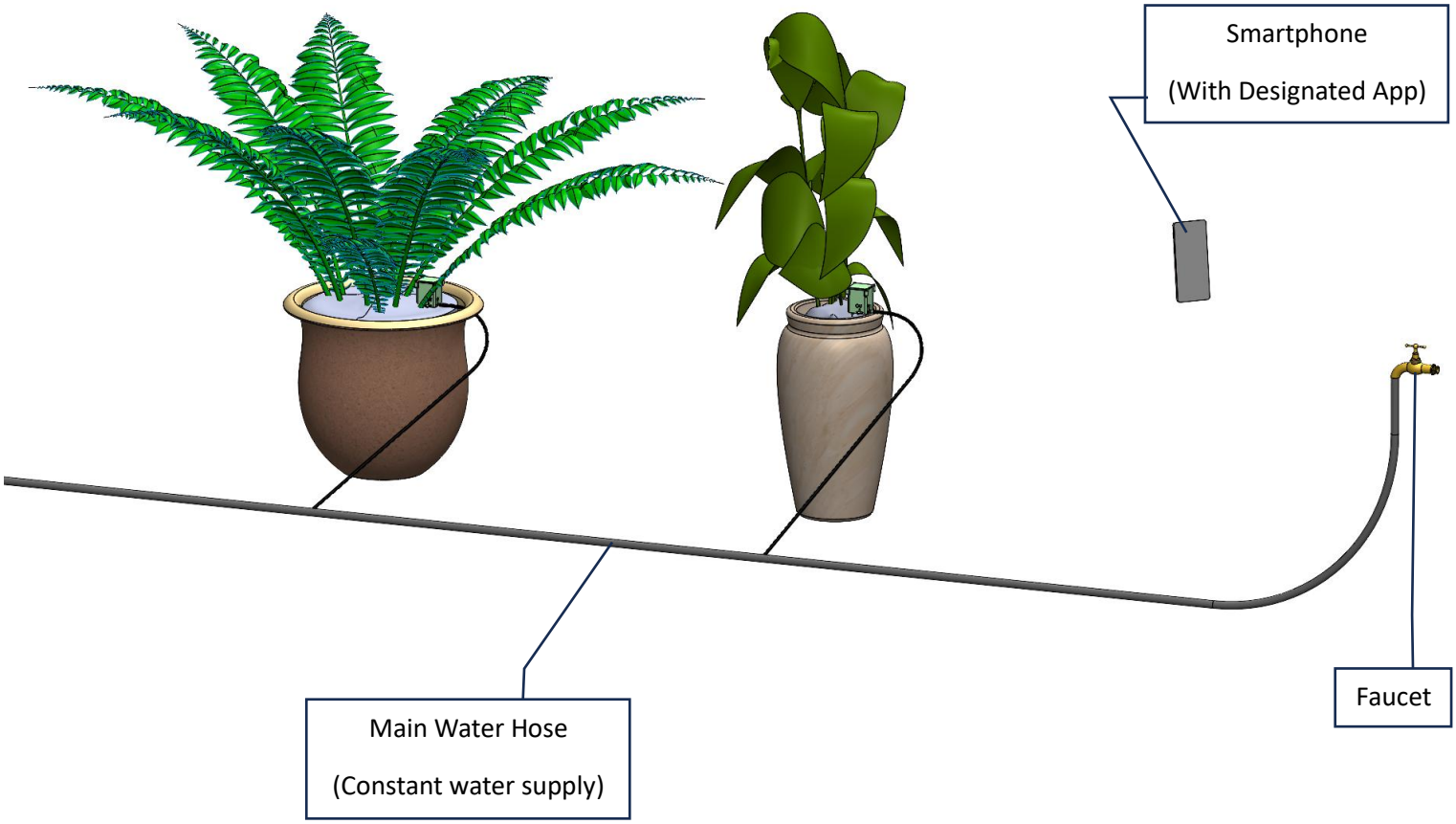


FIG. 2


Lithium
Polymer
Battery
PCB Featuring ESP microcontroller and NFC Function
Lithium Polymer Battery
OUT
IN
Latching Solenoid Valve


Smartphone
(With Designated App)
Main Water Hose
(Constant water supply)
Faucet

Battery Info

- Voltage: 3.7 V
- Capacity: 1200 mAh = 1.2 Ah
- Energy capacity:

  3.7 V×1.2 Ah=4.44 Wh=4,440mWh

⚙️ **Daily Power Usage Estimate**

1. Hibernation Mode

- ESP32 in hibernation ~ **2 µA**
- Duration: 24 hours – active time ≈ **23.988 hours/day**
- Daily consumption:

  2 µA×3.7 V×23.988 h=0.177mWh

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2. ESP32 Wake Time

- 2 wake-ups/day × 20 sec = **40 sec/day = 0.0111 hr/day**
- Assume ESP32 draws **50 mA avg during active mode**
- Daily consumption:

  50 mA×3.7 V×0.0111 h=2.05mWh

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3. Solenoid Valve

- 2 activations/day × 50 ms = **0.1 sec = 0.000028 hr/day**
- Assume valve draws **300 mA** during activation
- Daily consumption:

  0.3 A×3.7 V×0.000028 h=0.031mWh

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4. Capacitive Moisture Sensor

- 20 mA × 3.7 V × 10 sec/day = 20 mA × 3.7 V × 0.00278 hr
- Daily consumption:

  0.206mWh

📊 **Total Daily Consumption**

Total=0.177+2.05+0.031+0.206=2.464mWh/day

🔋 Battery Life Estimate

4440 mWh / (2.464 mWh/day) ≈ 1,802 days ≈ 4.93 years

✅ Conclusion

With your given specs:

- **Estimated battery life: ~4.9 years**
- **We could realistically expect 4+ years.**