Below is a serious, engineering-grade hardware selection optimized for LOW POWER + REAL DEPLOYMENT

1. SYSTEM ARCHITECTURE :

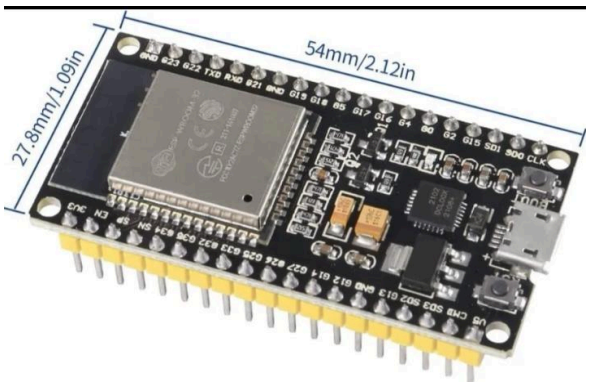
Core functions:

- Valve control (open/close)
- Water flow / system monitoring (optional but recommended)
- Wireless communication
- Ultra-low power operation (battery/solar ready)

2. ENGINEERING-GRADE COMPONENT SELECTION :

1. Microcontroller (Main Control Unit) :

- Part: ESP32-WROOM-32D
- Manufacturer: STMicroelectronics



Key Specs:

- Supply: 3.0–3.6V ﷺ
- Espressif Documentation
- CPU: Dual-core up to 240 MHz
- Deep sleep current: ~10–150 µA (practical design)
- Core: ARM Cortex-M0+
- Flash: 192 KB
- RAM: 20 KB
- Voltage: 1.65–3.6 V
- Active current @ 32 MHz: ~120 µA/MHz
- Stop mode with RTC: ~300 nA

- Standby RTC: ~150 nA

Power Consumption:

- Active Wi-Fi: ~80–240 mA
- Iscte Repository
- Deep sleep: <150 µA

Why selected:

- Industry standard
- Supports sleep modes
- Enough GPIO + ADC
- Easy firmware ecosystem

Justification :

- Industry-grade ultra-low power MCU
- Deep sleep ≈ nano-amp range
- More efficient than ESP32 (which is Wi-Fi heavy)
- Enough processing for command parsing, GPS management, GSM comms
- Readily available worldwide

2. Valve :

Do NOT use:

- Normal solenoid valve → continuous current (wastes power)

Use:

- Latching Solenoid Valve (12V DC)
- Part: 12V Latching Solenoid Valve

Key Specs:

- Actuation: Pulse (20–50 ms)
- No holding current required
- Typical coil current: 200–500 mA (only during pulse)

Power Consumption:

- Energy per actuation ≈ VERY LOW (milliseconds only)

Why selected:

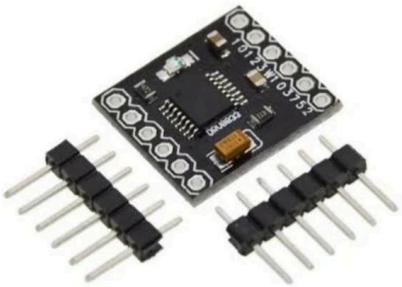
- Zero steady-state power
- Industry irrigation standard
- Daviteq Technologies Inc

Justification

- Zero static load ⇒ huge power savings
- Real irrigation valve quality
- Widely used in industrial agricultural systems

3.Valve Driver (Polarity Control Required) :

- Part: DRV8833 Motor Driver



Key Specs:

- Supply: 2.7V–10.8V
- Dual H-bridge
- Peak current: 1.5A

Why needed:

- Latching valve requires:
- +Pulse → OPEN
- Reverse pulse → CLOSE

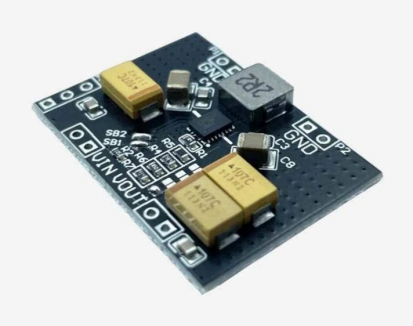
Power:

- Idle current: very low (<1 mA)

5. Power System (CRITICAL FOR LOW POWER) :

Core Regulator:

- Part: TPS63020 Buck-Boost Converter



Key Specs:

- Input: 1.8V–5.5V

- Efficiency: up to 96%
- Output: stable 3.3V

Why selected:

- Works with:

  Li-ion battery (3.0–4.2V)

- Maintains stable voltage even when battery drains

Battery Recommendation:

- 18650 Li-ion (3.7V, 2200–3000mAh)

Optional (Recommended):

- Solar panel (5–6V, 1–3W)

Real System Example:

- Sleep current: <100 μA
- Lifetime: months to years (depending transmission)

6.Monitoring (WITHOUT SOIL SENSOR) :

Since we removed soil sensor, use:

Option A: Flow Sensor (Recommended)

- Detect water usage
- Detect leakage

Option B: Pressure Sensor

- Detect pipeline failure

7.GSM (Cellular Communication)

- SIM7000E NB-IoT / LTE CAT-M
- Part Number: SIM7000E-NB
- Manufacturer: SIMCom

KEY ELECTRICAL SPECS :

- Bands: LTE CAT-M, NB-IoT
- Supply: 3.4–4.2 V (4V typical)
- RX current: ~50 mA
- TX peak current: ~300–700 mA (short bursts)
- Sleep (PSM): <10 µA

POWER CONSUMPTION (Typical)

Mode	Current
Idle	~8 – 22 mA
Transmit Burst	~300 – 700 mA
Deep Sleep	<10 µA

Justification :

- Modern low-power cellular standard
- Sleep and power saving modes (PSM, eDRX)
- Works with NB-IoT, reducing daily energy
- Real SIM slot + carrier support globally

8.GPS (Location Module) :

- u-blox NEO-6M / NEO-7M / NEO-8M
- Part Number: NEO-6M-0-001
- Manufacturer: u-blox

- We can choose NEO-7M/8M for better accuracy

KEY ELECTRICAL SPECS :

- Supply: 2.7–3.6 V
- Acquisition:
- Hot: ~22 mA
- Warm: ~35 mA
- Cold: ~45 mA
- Time to first fix: ~30s (cold)

Power :

Mode	Current
Tracking	22 – 35 mA
Cold Startup	45 mA
Standby	~1 mA

Justification

- Proven, well documented GPS
- Easily interfaced with UART
- Excellent balance of performance & cost

TOTAL POWER REQUIREMENT (FULL SYSTEM) :

System Components Considered

- MCU: STM32L072
- GSM: SIMCom SIM7000E
- GPS: u-blox NEO-6M
- Driver: DRV8833

- Valve: 12V Latching Solenoid
- Regulator: TPS63020

1.PEAK POWER (Worst Case Scenario) :

- This is when everything is ON simultaneously (very important for design):

  Current :

Component	Current
MCU	~10 mA
GSM (TX burst)	**700 mA**
GPS	45 mA
Driver	10 mA
Valve Pulse	400 mA

Total Peak Current:

$$I_{peak} = 10 + 700 + 45 + 10 + 400 = \mathbf{1165\,mA} \approx \mathbf{1.2\,A}$$

Peak Power:

Assuming 3.7V battery:

$$P = V \times I = 3.7 \times 1.2 = \mathbf{4.44\,W}$$

*How much power does your system require ?

“The **system requires approximately 4.4 W peak power** during GSM transmission and valve actuation, while the average operating power is below 1 W, and in sleep mode it drops to just a few milliwatts, ensuring long battery life.”

Interfacing Of ESP 32 :

Smart Irrigation Valve Control & Monitoring System