**Smart Aquarium IoT project**

**1. ESP32-WROOM-DA**

**Specifications:**

- Dual-core 32-bit LX6 processor.

- 4 MB Flash memory.

- Integrated Wi-Fi and Bluetooth.

- Dual antennas for better wireless coverage.

**Usage:**

- Serves as the central controller.

- Manages sensors and actuators.

- Establishes TCP communication for remote control and monitoring.

- Hosts the Wi-Fi connection for IoT functionality.

**2. Temperature Sensor (DS18B20)**

**Specifications:**

- Range: -55°C to 125°C.

- Accuracy: ±0.5°C (between -10°C to +85°C).

- Digital one-wire communication.

**Usage:**

- Monitors water temperature in real-time.

- Connected to ESP32 via GPIO4.

- Sends temperature readings for alerts when outside the ideal range.

**3. Turbidity Sensor**

**Specifications:**

- Voltage Output: Analog signal (0 to 4.5V).

- Detection Range: 0–3000 NTU (Nephelometric Turbidity Units).

**Usage:**

- Measures the clarity of the aquarium water.

- Connected to ESP32 via GPIO32 (ADC).

- Helps in assessing water quality.

**4. Water Level Sensor**

**Specifications:**

- Voltage Output: Analog signal (0 to 3.3V).

- Measures water level height.

**Usage:**

- Monitors water level inside the aquarium.

- Connected to ESP32 via GPIO33 (ADC).

- Triggers the pump via relay when water level is too low.

**5. pH Sensor**

**Specifications:**

- Measurement Range: 0–14 pH.

- Output: Analog signal (0 to 3.3V).

- Accuracy: ±0.1 pH.

**Usage:**

- Measures the pH level of the aquarium water.

- Connected to ESP32 via GPIO34 (ADC).

- Alerts the user if pH falls outside the ideal range.

**6. Servo Motor**

**Specifications:**

- Operating Voltage: 4.8–6V.

- Movement Range: 0–180°.

- Controlled by PWM signals.

**Usage:**

- Automates fish feeding mechanism.

- Connected to ESP32 via GPIO26.

- Rotates periodically to dispense food into the aquarium.

**7. Relay Module**

**Specifications:**

- Operating Voltage: 5V.

- Max Load: 250V AC or 30V DC (10A).

**Usage:**

- Controls the water pump.

- Connected to ESP32 via GPIO25.

- Turns the pump ON or OFF based on water level conditions.

**8. Power Supply**

**Specifications:**

- ESP32 Input Voltage: 5V (via USB or external adapter).

- Sensors: Operate on 3.3V from the ESP32.

- Servo Motor and Relay Module: Operate on 5V (external supply recommended for higher current needs).

**Usage:**

- Powers all components.

- Ensures stable and adequate power delivery for continuous operation.

**9. Wi-Fi Network**

**Specifications:**

- 2.4 GHz Wi-Fi connection.

**Usage:**

- Facilitates TCP server-client communication between the ESP32 and a mobile/PC.

- Enables remote monitoring and control of the aquarium system.

**10. Jumper Wires and Resistors**

**Specifications:**

- Resistor: 4.7kΩ pull-up resistor for DS18B20.

**Usage:**

- For electrical connections between sensors, actuators, and the ESP32.

- Ensures stable connections and proper signal conditioning.