

Hardware Implementation Guide: Aqua Track

Goal: Build the physical device that measures water level and sends it to the cloud. **Time:** 1-2 Hours **Difficulty:** Beginner (No soldering required if using jumper wires)

Part 1: Bill of Materials (BOM)

Component	Quantity	Description
ESP32 Dev Board	1	The "Brain" with Wi-Fi. (Do not use ESP8266, ESP32 is better for SSL/Firebase).
JSN-SR04T	1	Waterproof Ultrasonic Sensor. (Essential for humid tanks).
5V Power Adapter	1	A standard micro-USB phone charger works perfectly.
Jumper Wires	4	Female-to-Female (or Male-to-Female depending on board).
Waterproof Box	1	IP65 rated junction box to keep the ESP32 dry.

Part 2: Wiring Diagram

Connect the **JSN-SR04T Board** (the small green PCB) to the **ESP32**.

- **VCC** (Sensor) → **VIN** or **5V** (ESP32)
 - *Note: The sensor needs 5V. Do not connect to 3.3V.*
- **GND** (Sensor) → **GND** (ESP32)
- **TRIG** (Sensor) → **GPIO 5** (ESP32)
- **ECHO** (Sensor) → **GPIO 18** (ESP32)

Part 3: Physical Installation (The Tank)

1. Drill the Lid:

- Take the plastic lid of your water tank.
- Drill a **22mm hole** in the center (or wherever you want the sensor).
- **Crucial:** Ensure the sensor looks straight down at the water, not hitting the walls of the tank.

2. Mount the Sensor:

- The JSN-SR04T probe acts like a screw. Remove the nut, push the wire through the hole from the bottom, and tighten the nut from the top.
- The waterproof probe stays *inside* the tank. The wire comes *out* to the roof.

3. Mount the Electronics:

- Place the ESP32 and the small green Sensor PCB inside your **Waterproof Box**.
- Mount this box on the wall or pipe next to the tank.
- **Do not** put the electronics inside the tank. Humidity will kill them.

4. Power Up:

- Run the USB cable from the ESP32 to your nearest power socket.

Part 4: Firmware Upload Steps

1. Install Arduino IDE: Download from [arduino.cc](https://www.arduino.cc).

2. Install ESP32 Board Manager:

- File > Preferences > Additional Boards Manager URLs:
`https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json`
- Tools > Board > Boards Manager > Search "esp32" > Install.

3. Install Firebase Library:

- Sketch > Include Library > Manage Libraries.
- Search for "**Firebase Arduino Client**" (by Mobizt).
- Install the latest version.

4. Flash the Code:

- Copy the code from `esp32_firmware.ino` (provided below).
- Update the **Wi-Fi** and **API Key** sections.
- Connect ESP32 via USB.
- Select Board: **DOIT ESP32 DEVKIT V1**.
- Click **Upload**.

Troubleshooting

- **Reading is stuck at 0% or 100%:**
 - Check if the sensor is perpendicular to the water. Angles reflect sound away.
 - JSN-SR04T has a **Minimum Blind Zone of 20cm**. If water comes closer than 20cm to the sensor, it will give garbage values. **Mount the sensor slightly higher** (e.g., on a small pipe riser) if your tank fills to the brim.
- **Wi-Fi connects but Firebase fails:**
 - Check your API Key.
 - Ensure your Firestore Database is set to **Test Mode** (or rules allow writes).
 - Check Serial Monitor (Baud rate 115200) for error messages.