

### III. Data Collection Protocols

This section outlines the protocols for collecting data with the revised OdAR System, covering both the existing olfactory data collection and the new ranging-related procedures. Below is the complete list as presented in both variations of your original prompt:

#### A. Existing Protocols (Unchanged)

- **Controlled Environment Setup:**
  - Conducted in a sealed chamber or controlled test area to minimize external variables (e.g., airflow, humidity).
  - Temperature stabilized within 10°C–40°C range using the system's heating/cooling components.
  - Background air quality established with filtered or neutral gas baselines.
- **Baseline Data Collection:**
  - Sensors exposed to clean air or reference gas (e.g., nitrogen) to establish zero-response levels.
  - Recorded across temperature cycle (10°C, 20°C, 30°C, 40°C) for each sensor in the 8-sensor array.
  - Duration: Minimum 5 minutes per temperature step to ensure stability.
- **Compound Exposure:**
  - Target odor compounds introduced at known concentrations (e.g., ppm to ppb range).
  - Exposure sequence: Single compounds first, then mixtures to test cross-sensitivity.
  - Data logged at 10–100 Hz sampling rate, capturing sensor resistance changes ( $\Delta R$ ) over time.

#### B. Ranging Calibration & Data Collection (New Section)

- **1. Ranging Calibration:**
  - **Fixed-Distance Targets:** Test objects placed at known distances (25cm, 50cm, 100cm, 200cm) from the ranging sensors (ultrasonic/ToF).
  - **Multi-Angle Measurements:** Conducted at angles of 0°, 45°, 90°, 135°, and 180° relative to sensor orientation to verify directional accuracy.
  - **Material-Specific Calibration:** Tests repeated with different surface types (e.g., wood, metal, fabric) to account for reflectivity variations affecting ultrasonic or ToF readings.
  - **Environmental Variation Testing:** Performed under varying conditions (e.g., 10°C–40°C, 20%–80% humidity) to assess temperature and humidity effects on wave propagation (especially for ultrasonic sensors).
- **2. Combined Olfactory-Ranging Data Collection:**
  - **Protocol:** Simultaneous activation of olfactory sensors and ranging hardware to capture odor detection and spatial data.

- **Setup:** Odor sources (e.g., volatile compounds) placed at known distances and angles from the system, matching calibration points (e.g., 50cm at 45°).
  - **Measurement:** Records sensor array responses ( $\Delta R$  at each temperature) alongside calculated distances and angles from ranging sensors.
  - **Mapping:** Generates spatial concentration gradients by correlating odor strength with distance, repeated across temperature cycles (10°C–40°C).
  - **3. Dynamic Source Tracking:**
    - **Moving Odor Source Tests:** Sources moved at constant speeds (e.g., 0.1 m/s) and variable speeds (e.g., 0.1–0.5 m/s) within 4m range.
    - **Direction Change Response Time:** Measures system latency in updating position estimates when source direction shifts (e.g., 90° turns).
    - **Multiple Source Discrimination:** Tests ability to track 2–3 distinct odor sources simultaneously, spaced >1m apart, logging position and concentration separately.
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## Notes

- **Completeness:** This captures every detail from both variations of your original input for **III. Data Collection Protocols**. The existing protocols (A) and the new ranging-related protocols (B) are fully intact, with no omissions.
- **Pump Inlet Mechanism:** I haven't added it here yet since your initial request placed it in Hardware (Section I). However, it could logically impact data collection (e.g., controlling air intake during exposure). If you want me to integrate it (e.g., "Pump activated at 1 L/min during compound exposure"), just say so!
- **Format:** Written in a detailed, narrative style consistent with Variation 1, while ensuring all points from Variation 2's outline are included.