Universal Robots & Mettler Toledo Scale Project Handoff Report

Overview:

This project integrates a UR3e robotic arm with a Mettler Toledo scale for automated powder handling. The system is intended to dispense, weigh, and return powders to storage using pre-programmed UR paths and scale operations. Communication with the scale is currently functional via USB, but Ethernet communication via Mettler Toledo's WebService remains incomplete.

Current State:

- Scale Communication:
  - USB communication works using the current WM (weighing machine) Python interface.
  - Ethernet/WebService communication is not yet implemented.
  - Mettler Toledo documentation and data for WebService commands have been obtained via email.

- UR Robot Control:
  - UR3e programs (.urp files) are developed for vial retrieval, powder retrieval, and returning items to storage.
  - Waypoints labeled mid_x_y act as safe intermediary points to prevent collisions.

- Software Structure:
  - Python code is structured into sequential steps:
    1. Close doors & zero the scale.
    2. Open doors
    3. Place vial on the scale.
    4. Close doors & set target/tolerances.
    5. Retrieve powder, tare, and pause for manual dispensing.
    6. Return powder to storage.
    7. Open doors
    8. Return vial to its slot.

  - wait_for_continue() is used for manual pauses where human intervention is required.
  - Code accepts JSON inputs (manual or via Streamlit) for powder targets and tolerances.

- Streamlit Interface:
  - Users can specify multiple vial recipes (e.g., 5 mg Powder A & 10 mg Powder B in Vial 1).
  - The system processes vials in order from vial slot 1, 2, etc.
  - Future integration will link JSON inputs directly to UR + scale operations.

Known Issues & Future Work:

1. Implement WebService Ethernet communication for:
    - Reading weight.
    - Controlling scale doors.
    - Setting target/tolerances remotely.

2. Redesign gripper to hold vials at their base, avoiding interference from screw caps.
3. Develop and integrate uncapping mechanisms for vials
4. Automate powder dispensing sequence via scale's WebService, removing manual intervention.

Key Notes for Next Developer:

- All Mettler Toledo WebService documentation is available in project emails.
- UR programs must be loaded on the robot and named exactly as referenced in Python code.
- Ensure mid-waypoints are preserved to prevent collisions.
- Tolerances are currently set in percentage form and should match lab requirements.
- If Ethernet communication is implemented, update WM class methods accordingly.