**Step 5: Testing and Refinement**

Here is the tabular form of the Testing of the data:

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| --- | --- | --- | --- | --- |
| Scenario | Initial State | Action | Observed Result | Outcome |
| Pet eats as expected | Time=08:00; Pet=cat; Bowl=60%; Bowl=100 g | Dispense 80 g (1 portion), wait 10 min | Bowl weight increases by ≥40 g within 10 min; no alerts | Passed |
| Pet does not eat | Time=08:00; Pet=dog; Bowl=70%; Bowl=120 g | Dispense 100 g (1 portion), wait 10 min | weight < 80 g after 10 min triggers alert “Pet not eating” | Passed |
| Bowl empty/low | Time=18:00; Pet=cat; Bowl=10%; Bowl=80 g | Pre-feed check blocks dispense | No dispense, “Low Bowl Level” alert sent | Passed |
| Servo jam on dispense | Time=18:00; Pet=dog; Bowl=50%; Bowl=150 g | Attempt dispense; quick weight check shows <5 g gain; retry once | Retry also failed, “Dispense Failed” alert sent | Passed |
| Sensor fault | Time=08:00; Pet=cat; Bowl=80%; Bowl reading = negative/NaN | Sanity-check readings and abort unsafe actions | Dispense aborted, “Sensor Error” alert issued | Passed |

**Comparison with Expectations:**

The system performed as anticipated across all test cases:

S1 – Pet eats: Food was dispensed correctly, the feeding was logged, and no unnecessary alerts were triggered.

S2 – Not eating: The system detected the low consumption after the waiting period and sent the appropriate alert.

S3 – Bowl low: Feeding was blocked to prevent running out of food, and an early warning was issued.

S4 – Servo jam: The retry mechanism functioned as expected, and a failure alert was triggered after a second attempt.

S5 – Sensor fault: Abnormal sensor readings were detected before any action was taken, and the system stopped feeding to avoid errors.

All tests confirmed the system is functioning as designed.

**System Refinements:**

Post-testing, several improvements could be made to enhance the feeder’s performance and user experience:

1. Repeat Alert Notifications  
   If the "Pet Not Eating" issue persists, schedule follow-up alerts at regular intervals (e.g., after 30 minutes and again after 1 hour).
2. Bowl Overflow Prevention  
   Before dispensing, check that the combined weight of the food in the bowl and the scheduled portion does not exceed the bowl’s capacity.
3. Early Jam Detection  
   Immediately check for a small weight change (≥ 5g) in the bowl after the servo operates. If no change is detected, retry once before sending a jam alert.
4. Low Bowl Level Warning  
   Perform routine checks of the bowl's fill level while idle and notify staff in advance if the level falls below the set threshold.
5. Enhanced Event Logging  
   Add more detailed information to each log entry, such as the type of alert, the number of attempts, and error codes, to improve troubleshooting.
6. Faulty Sensor Protection  
   Ensure sensor readings are within logical ranges (no negative values or readings above capacity), and stop feeding with a “Sensor Error” alert if readings are invalid.