

Fall Validation Demonstration (FVD)

Team H: Arnav Kharbanda · Farnaz Alam Ahmed · Juan Muerto · Karthik Srinivasan

Date: September 16, 2026 FVD Target Date: November 16, 2026 FVD Encore: November 23, 2026

Overview

The FVD demonstrates a minimal viable product version of APEX Labs: an autonomous mobile manipulation system that carries a well plate through a full lab workflow - dispensing, shaking, and output - while detecting anomalies along the way. It is the capstone integration test validating that mobility, perception, planning, and manipulation subsystems work together semi-autonomously.

Objective	Perform an experiment semi-autonomously, end-to-end.
Subsystems	User Interface, Perception, Planning, Manipulation, Lab Machine Integration, Monitoring, Navigation
Location	Newell Simon Hall (NSH Caged Area)
Equipment	Computer, XArm-6, APEX Labs mobile base platform, ZEDx + webcam, OpenTron OT-2, custom shaker module, well plates
Personnel	Arnav, Farnaz, Karthik, Juan (full team)

Demonstration Procedure

- User enters an experiment description via the UI.
- XArm-6 scans the environment to detect necessary equipment.
- Perception detects, segments, and localizes equipment; reports any anomalies (whether pipette is clogged) to the UI.
- Planning generates a grasp/move/place plan into the OT-2; Manipulation executes it.
- OT-2 dispenses liquid from a pre-filled test tube rack.
- The wellplate is then moved to the slot in the base, and then the base navigates to the shaker module.
- Planning generates a plan to move the plate to the shaker module; Manipulation executes it.
- Shaker module runs for 30 seconds.
- Planning generates a plan to move the plate to the output bin; Manipulation executes it.

Verification Criteria

- System completes the experiment end-to-end without manual intervention beyond the OT-2 slot press.
- Placement of equipment is performed within a ±5 mm error bound.
- Grasping is performed with 75% accuracy

Mandatory Requirements Exercised

M.F.3 Recognize (90% acc., ≤5% FP) · M.F.4 Localize (≤3cm, ≤5°) · M.F.5 Plan (≥95% collision-free) · M.F.6 Grasp (≥70% success) · M.F.7 Place (≥90% success) · M.F.8 Command Lab Machines (100% correct) · M.F.9 Detect Anomalies (≥80% success)