

T.P.10 - Fall Validation Demonstration	
Objectives	
Validate the complete system by demonstrating an autonomous security-patrol mission from mission selection through anomaly detection, robot investigation, operator decision, and patrol resumption.	
Equipment	Fully integrated Husky patrol robot (Orin, LiDAR, Camera, IMU/GNSS), One or more IoT towers (DGX Spark, Camera, Power Bank), Mission Manager Computer
Elements	IoT Subsystem, Husky Robot Subsystem, Anomaly Detection Subsystem, Mission Manager Subsystem
Personnel	Pin-Wen (Maddie) Wang, Hongyi (Sam) Dong, Tzu-Cheng(Joshua) Tsai, Chenxi (Leo) Xu, Po-Ting (Koko) Ko
Location	In front of Newell-Simon Hall, around Smith Hall
Preconditions	• The robot and IoT towers are online and their positions are located on the map.. • The patrol map and permitted lanes are loaded. • Network connectivity is verified. • A predefined mission has been saved. • There is mission history in the database.
Procedure	
1. The operator opens the dashboard and loads a saved mission containing multiple patrol waypoints. 2. The operator edits the mission based on AI generated heatmap. 3. The system generates route, and starts the mission after operation confirmation. 4. The robot autonomously follows the route while the dashboard displays robot mission status and all device status. 5. A participant enters the monitored area and performs the selected anomaly scenario. 6. The system detects and tracks the participant, identifies the anomaly and displays an alert. 7. The mission manager redirects the robot to the anomaly location. 8. The robot autonomously reaches the designated observation location and displays the robot's live camera stream for visual verification. 9. The operator verifies the event as either confirmed or false, then, dismisses/resolves the alert. 10. The robot resumes its interrupted patrol and completes the remaining waypoints.	
Verification Criteria	
1. Mission loading and editing: The saved mission loads within 5 seconds, displays 100% of its saved waypoints, and reflects all operator edits based on the AI heatmap within 2 seconds. 2. AI heatmap: The heatmap appears within 10 seconds, covers at least 95% of the designated patrol area, and enables the operator to add, remove, or reposition at least one waypoint. 3. The route is generated within 1s after confirmation, includes 100% of the selected waypoints. 4. The robot reaches 100% of the patrol waypoints with zero collisions and zero safety interventions. 5. The dashboard displays each devices status with refresh rate of 2hz. 6. The participant is detected within 50ms of entering the monitored area, and the same tracking ID is maintained for at least 90% of the participant's visible trajectory. 7. The 3 selected anomaly, including lying down, trespassing, loitering, is correctly classified with f1 score greater than 90, localized within 1.5 m of ground truth, and displayed as an alert greater than 5 seconds of satisfying the defined anomaly condition. 8. The robot begins executing the investigation route within 5 seconds of alert generation and reaches the closest lanelet point next to observation site within 1.0 m. 9. The live stream appears within 5 seconds after arrival and the system records the event within 3 seconds upon operator confirmation.	

Table 11: Fall Validation Demonstration