AR MRS 2025 Course

Open Project Plan Template

Return the project plan in PDF format to the course's Moodle page by 05.05.2025.

1. Team name and team members

Group 5
Vasista Kodumagulla
Chathuranga Liyanage
Jinyu Lin

2. Application / Use-case

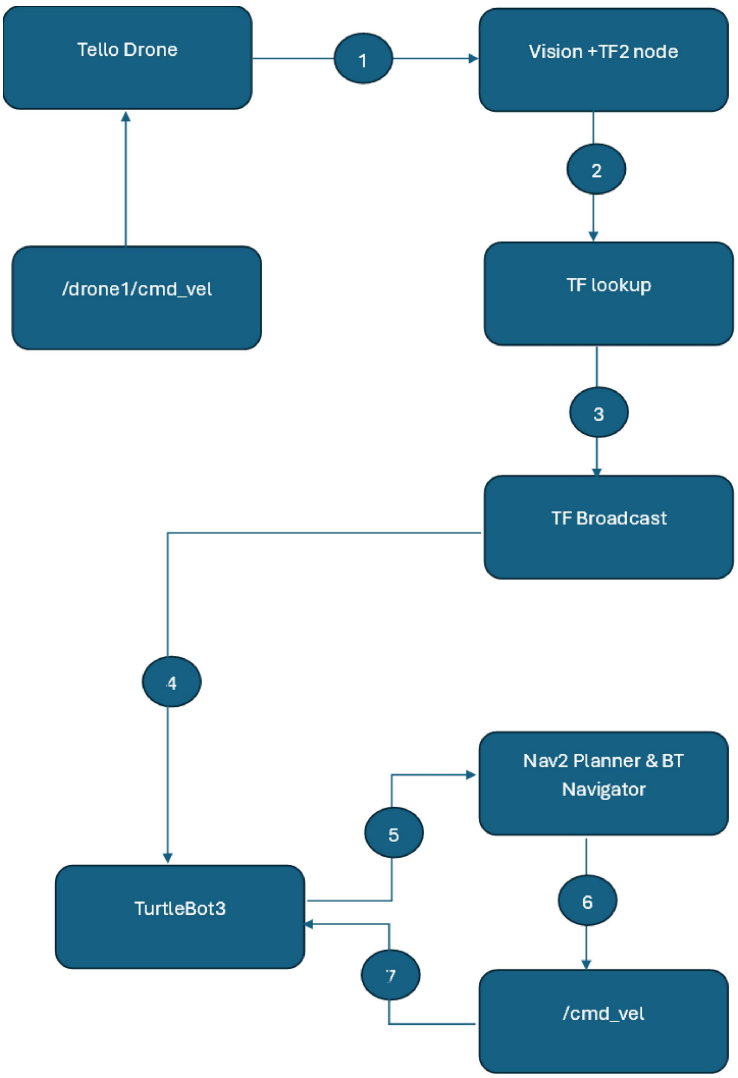
Co-operative courier box search and pickup indoors.
A Tello scans an indoor lab for a red/April tagged cube that needs to deliver to the customer. When the cube is found, it publishes an accurate pose; a TurtleBot 3 Burger then drives autonomously to the location for close inspection or pickup.

Why we chose it:

- Demonstrates multi-robot coordination with bidirectional data flow
- Shows the strengths of each platform: aerial speed for search, ground stability for manipulation.
- Directly apply to warehouse application but achievable with off-the-shelf hardware.

3. The system

Robots & compute	1 × Tello EDU(Wi-Fi), 1 × Turtlebot 3 Burger (Raspberry Pi 4 GB), 1 × Ubuntu 20.04 laptop (ROS 2 Humble built from source)
Sensors	Tello RGB (640 × 480 @ 30 fps); Turtlebot lidar (RPLidar A1), wheel odom, IMU
Communication	ROS 2 DDS over 5 GHz Wi-Fi; namespaces /drone1/*, /tb3/*; static IP router
Algorithms	April tag/fiducial detection for the cube (fallback: HSV-threshold + contour filter), SLAM Toolbox offline map + AMCL localisation Nav2 SmacPlanner2D (global) + Regulated Pure Pursuit (local) (TBD).
Data flow	Camera → vision node → TF 2 frame cube (child of tello) → TF lookup (map←cube) on laptop → NavigateToPose goal → Nav2 BT Navigator → /cmd_vel



4. Background

Confidence	What we already know
High	ROS 2 node writing, pub/sub, Basic HSV / April tags detection.
Medium	TF 2 library usage
Low	Launching Nav2 with default parameters, building static maps, Behavior-tree tuning for sub-15 cm goal tolerance, robust vision under variable lighting

5. Expected challenges and wishes to learn

Challenge	Mitigation / what we'll learn
TF gaps if /clock drifts	Broadcast transforms at 50 Hz; verify with tf2_echo; study TF buffering
Planner oscillates near cube	Tune inflation radius & goal_xy_tolerance; experiment with Regulated speed params
Nav2 source compile time	Cache ~/nav2_ws; rebuilt only when required
Lighting ruins colour detection	Compare HSV vs apriltag_ros, choose threshold ranges
TurtleBot reaching its exact goal position	Tune costmap inflation / goal_xy_tolerance, learn dynamic re-planning to ensure the goal is reached by the TB without much of drift from the original path since TBs are usually meant to drift over the time and we will have to ensure they track back onto the path.

6. Team roles

Member	Deliverables
Vasista	TB3 + Nav2 bring-up;
Chathuranga	Port draft Tello Node logic to Gazebo camera; TF broadcaster
Lin	Build Industrial_lab.world; write install script & CI, documentation

7. Description of final experiment or demonstration.

Launch: chemical_lab.world (Tello at (0,0,1 m), TB3 at map origin).

Mission

1. Place April tagged cube (courier box) randomly.
2. Press *Start*. Drone takes off, rotates until cube detected.
3. TF lookup → NavigateToPose goal.
4. TB3 drives; success when distance (cube, base_link) ≤ 1m.

Metrics logged: detection time, path length, final pose error, TF dropouts.

Deliverables: GitHub repo (code + install), world SDF, video screen recording, 2-page PDF report.

Date	Milestone
03 May 2025	Draft plan ready
05 May	Submit plan PDF
09 May	Tello + Vision node live in Garden
16 May	Nav2 drives TB3 to dummy goal
23 May	End-to-end mission in sim
30 May	Screen-record demo & freeze docs
≤ 05 Jun	Final video + Git push