

## Problem Statement:

- Design and implement a system where a **TurtleBot3** robot in a **custom Gazebo map** autonomously navigates to **user-selected waypoints**, chosen via a **simple GUI (e.g., Tkinter or PyQt)**.
- The goal is to evaluate both your **ROS 2 navigation understanding** and your ability to **integrate external interfaces** with the ROS 2 ecosystem.

You are required to:

### 1. Set up the simulation environment

- Use **TurtleBot3** in any **custom 2D Gazebo map** (can be hand-made or modified from `turtlebot3_world`).
- Ensure the full navigation stack works (`map_server`, `amcl`, `nav2_bringup`, etc.).
- Define at least **5 to 6 static waypoints** in world coordinates.

### 2. Develop a custom GUI (Tkinter / PyQt / any simple UI framework)

- Display 5 – 6 named waypoint buttons atleast,
  - Station A
  - Station B
  - Station C
  - Station D
  - Docking station
  - Home
- Allow the user to:
  - Select **one** waypoint → robot navigates to that goal and returns to home.
  - Select **multiple** waypoints → robot visits them sequentially and finally returns **home**.
- The GUI should show:
  - Navigation status (“Navigating...”, “Reached”, “Failed”, etc.)
  - Option to **stop/cancel** navigation.

### 3. Implement a ROS 2 Node (**waypoint\_manager\_node**)

- Subscribes to user input from GUI (topics, services, or actions).
- Sends goals to **Nav2's NavigateToPose action server**.
- Monitor feedback and result of each goal.
- If multiple waypoints are selected:
  - Navigate in the order selected.
  - After the last goal, return to **home pose**.
  - Handle goal failure or timeout gracefully.

### 3. Integration

- All components (Nav2 + GUI + waypoint node) should launch via a single ROS 2 launch file.
- RViz visualization must show waypoints and current goals

### Deliverables: ( 2 Videos and 1 Github repo link)

- First Video of showing,
  - Selecting One waypoint from GUI → Robot navigates from home to that selected Waypoint point and returns back to Home.
- Second Video of showing ,
  - Selecting Multiple waypoints from GUI → Robot navigates to all the selected waypoints and returns back to Home
- Github Repo link of this project (Entire Workspace)