

Autonomous Ground Robot Navigation in Indoor Environments

Problem/Topic: Build a Turtlebot ground robot that can autonomously navigate and map indoor spaces using SLAM (Simultaneous Localization and Mapping) without GPS. Project focuses on sensor integration, 2D mapping and path-planning algorithms.

Level 1 – Foundational Sensing and Manual Navigation: (2 weeks)

- Set up TurtleBot (with ROS2) and verify sensor data streams
- Operate robot and log sensor data
- Implement very simple reactive obstacle avoidance (ex. Turn right when sense object < x cm)
- GOAL: robot drives safely without hitting anything

Distribution of Work:

- Chris Reed:
- Vinh Vu:
- Tao Wu:
- Krish:

Level 2 – LiDAR and IMU Path Planning: (3 weeks)

- Use LiDAR data to build 2D grid mapping of indoor environment
- Gather filtered IMU data using publisher and subscriber nodes to log position, orientation, and acceleration of the robot
- Write algorithm to integrate IMU data with 2D grid map to create path-planning routes and execution with obstacle avoidance

Distribution of Work:

- Chris Reed:
- Vinh Vu:

- Tao Wu:
- Krish:

Level 3 – 3-D Semantic Mapping and Path Planning: (only after level 2 is complete)

- Tune parameters for smoother navigation and greater accuracy
- 3D SLAM using depth camera (RealSense, Kinect)
- Semantic mapping (identify rooms, hallways, doors)
- Fleet coordination for two robots

Timeline

Level	Target Completion	Data Range
Level 1	End of Week 2	Nov 10- Nov 23
Level 2	End of Week 5	Nov 24- Dec 14
Level 3 (optional)	Week 5	Dec 9 -Dec 14

Meeting Norms

- Where will your meetings be held?
 - Primary: On campus at Northeastern (Snell Library study rooms or lab space)
 - Secondary: Virtual via Zoom for quick check-ins or when scheduling conflicts arise
 - Lab work: Robotics lab on campus for hands-on hardware testing and integration
- How often do you think the team will need to meet outside of class? How long do you anticipate the meetings will be?
 - Weekly meetings: 2 times per week outside of class

- Duration: 1-1.5 hours per meeting for planning and updates
 - Lab sessions: 2-3 hours as needed for hardware work and testing
 - More frequent meetings expected near project milestones and deadlines
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- Will you have specific meeting times, or will you decide on the next meeting at the end of the previous one?
 - Recurring weekly time slots: Tuesdays 4:45 – 6:00 pm, Thursdays 10:30 am – 11:30 pm
 - Additional meetings will be scheduled at the end of the previous meeting or via group chat, as needed
 - Lab sessions scheduled as the team needs them, with a two-day notice to ensure space and team members will be available
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- How will you follow up with teammates who need to miss a meeting?
 - Notify the team at least 24 hours in advance via group chat
 - Review meeting notes and action items shared in Google Doc within 24 hours
 - Coordinate a 15-min catch-up call with the absent team member if major decisions were made
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- What are your expectations for meeting attendance?
 - All team members expected to attend weekly meetings
 - Maximum two unexcused absence per month
 - Must notify team beforehand for planned absences
 - Emergency absences are understood if there is communication with the team ASAP, with makeup responsibilities

Communication Norms

- What platform(s) will you use to communicate with each other?

- Group text (WhatsApp) for daily communication and quick updates
 - Email for formal communications and document sharing
 - Video calls: Google Meets, Zoom, or Microsoft teams for virtual meetings
 - Project management: Notion for task tracking
- What software will you use for documents and presentations?
 - Google Docs/Sheets for collaborative writing and meeting notes
 - GitHub for code version control
 - PowerPoint for final presentation
 - Google Drive folder for storage
 - Are there specific hours, days, or dates that a teammate will not be available?

Vinh	Has classes everyday from 9:15AM to 11AM, T,F on afternoon from 1:30 –3:30PM.
Krish	
Chris Reed	Has classes on Tuesday and Friday from 1:30 to 3:15 pm.
Tao Wu	Has classes on Monday, Wednesday, and Friday from 11:00 AM to 2:00 PM

Work Norms

- How will work be divided among team members? How will you decide who should do which tasks?
- Where will you record who is responsible for which tasks?
 - LiDAR/sensors integration: [Krish]
 - SLAM algorithms: [Vinh]
 - Path planning: [Tao]
 - Hardware/mechanical: [Chris]
 - Rotate documentation and presentation responsibilities – Krish, Chris
 - Pair programming for complex algorithms – Krish, Vinh

Use shared Google Sheet. Each task has: owner, deadline, status (not started/in progress/completed). Will be updated at every meeting or when a new task arises.

What will happen if someone does not follow through on a commitment (e.g., missing a deadline, not showing up to meetings)?

- First occurrence: Team discussion and deadline extension if reasonable
 - Repeated occurrences: Redistribute work and notify professor
 - Emergency situations: Communicate immediately and team provides support
- What will you do if one or more team members are not doing their share of the work?
 - Address privately first in one-on-one conversation
 - If unresolved, discuss as full team at next meeting
 - Document concerns and involve professor if pattern continues
 - How will the work be reviewed amongst the team?
 - Peer review system: Work reviewed by at least one other team member before integration
 - Weekly progress demos during team meetings
 - Code review via GitHub pull requests
 - What happens if people have different opinions on the quality of the work?
 - Discuss concerns with specific examples and data
 - Vote if consensus cannot be reached (majority rules)
 - Consult professor or TA for technical disputes
 - Prioritize "good enough" solutions that meet project requirements over perfection

Decision Making

- Do you need consensus (100% approval of all team members) before making a decision?
 - Major decisions (project direction, architecture changes): Consensus preferred, but 3/4 majority acceptable
 - Minor decisions (implementation details): 3/4 majority
 - Emergency decisions: Any two members can decide if time-critical, with team notification within 24 hours
- What will you do if one of you fixates on a particular idea?
 - If someone fixates on an idea, we'll discuss it openly, evaluate pros and cons as a team, and decide by majority vote if consensus isn't reached.

Please write all your names here to indicate that you have read and agree to these work norms:

Group 7: EECE 5554 Final Project Team

Names:

- Vinh Vu: ____ Vinh Vu ____
- Krish: ____ Krish Gupta ____
- Chris Reed: ____ Chris Reed ____
- Tao Wu: ____ Tao Wu ____

Date: ____ 11/04/2025 ____