Autonomous Behavior Report

Choice of Autonomous Behavior

For this assignment, I implemented **obstacle avoidance** as the autonomous behavior for the TurtleBot3 robot. The robot moves forward until it detects an obstacle in its path, at which point it alternates between **clockwise and anti-clockwise rotations** to avoid the obstacle before resuming forward movement. This approach ensures that the robot does not get stuck in a loop of turning in the same direction repeatedly.

Impact of the Tunable Parameter

The **linear velocity** of the robot was chosen as a tunable parameter, allowing for different movement speeds. Adjusting this parameter had a significant impact on the robot's behavior:

- **Lower velocity values** allowed the robot to react to obstacles more smoothly and take controlled turns.
- **Higher velocity values** resulted in faster movement but introduced challenges in obstacle detection and response time.
- **At very high speeds**, the robot occasionally failed to turn in time, leading to collisions with obstacles due to its momentum.

This highlights the importance of selecting an appropriate linear velocity to balance efficient movement and safe navigation.

Observations from Experiments

1. The **alternating turn direction strategy** prevented the robot from getting stuck in continuous rotations, making obstacle avoidance more effective.
2. **At moderate speeds**, the robot successfully navigated around obstacles without collisions, maintaining smooth movement.
3. **At high speeds**, the robot tended to crash into obstacles before fully responding, indicating that lower velocities are preferable for safe navigation.
4. A **Docker container** was created for the project, successfully enabling the obstacle avoidance node to function within the container.
5. However, **Gazebo simulation failed to load properly inside the container**, preventing full simulation execution through Docker. Running the simulation outside the container while executing the `obstacle_avoidance` node within Docker was a viable workaround.

Conclusion

The obstacle avoidance behavior proved to be effective at **moderate speeds**, successfully avoiding obstacles while maintaining forward movement. The experiments demonstrated that **linear velocity significantly influences the robot's ability to navigate safely**, with higher speeds reducing reaction time and increasing the likelihood of collisions. Future improvements could involve incorporating a dynamic speed adjustment mechanism based on obstacle proximity to optimize navigation performance.