

# TurtleBot the Explorer Report

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## Algorithm Implementation

The exploration algorithm consists of two primary components: global path planning using A\* search and local obstacle avoidance with LaserScan data. These components ensure efficient and collision-free navigation of the TurtleBot within the environment.

### Global Path Planning

Frontier-based exploration is used to identify unexplored areas. The algorithm first detects frontier cells, defined as the boundary between known and unknown regions of the occupancy grid. Clusters of frontier cells are grouped and scored based on size and distance. The A\* search algorithm computes the optimal path to the best frontier cluster using a Euclidean distance heuristic.

### Path Following and Navigation

Once a path is determined, the Pure Pursuit algorithm enables smooth path following. The robot calculates a target point along the path at a specified lookahead distance and adjusts its steering angle to minimize deviation. Speed is scaled down during sharp turns to improve stability.

### Local Obstacle Avoidance

While following the global path, the robot continuously monitors its surroundings using LaserScan data. If an obstacle is detected within the safety threshold, the robot halts forward motion and performs corrective angular maneuvers to avoid collisions. This ensures robust navigation even in dynamic or cluttered environments.

## Conclusion

The implemented algorithm combines global pathfinding (A\*) with local obstacle avoidance to enable efficient and autonomous exploration. The Pure Pursuit controller ensures smooth path tracking, while the LaserScan data prevents collisions, resulting in reliable navigation of the TurtleBot.