

Problem Description

The mission involves designing and building a TurtleBot3 Burger system equipped with a IR (heat) detection module and a projectile launcher capable of autonomously navigating a 5m x 5m maze with walls under 1m in height. Within the maze, the robot must locate a designated heat signature zone marked by an IR lamp enclosed in a randomly placed space and identify three "hot targets" — biscuit tins emitting infrared heat and marked with vertical position indicators 1.5m above them. Upon locating a hot target, the robot must orient itself, aim, and fire three ping pong balls at the vertical marker in a specified 2s–4s–2s timing sequence.

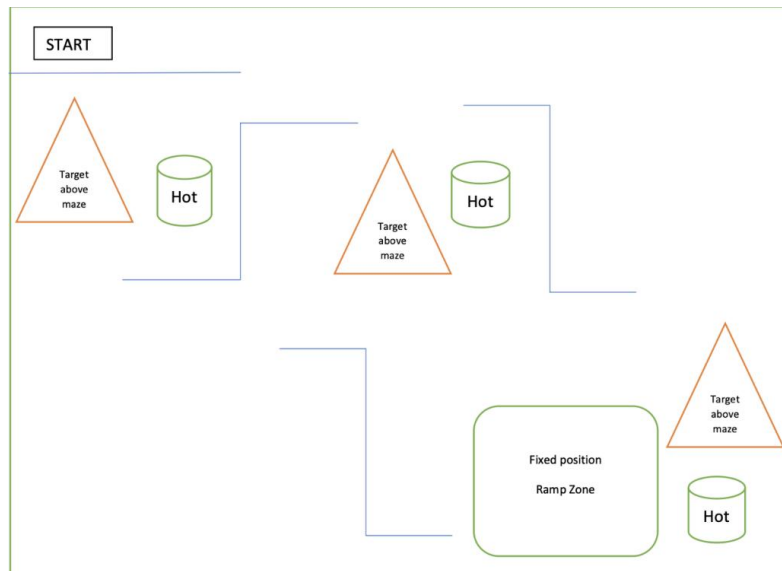


Figure 1: Mission Layout

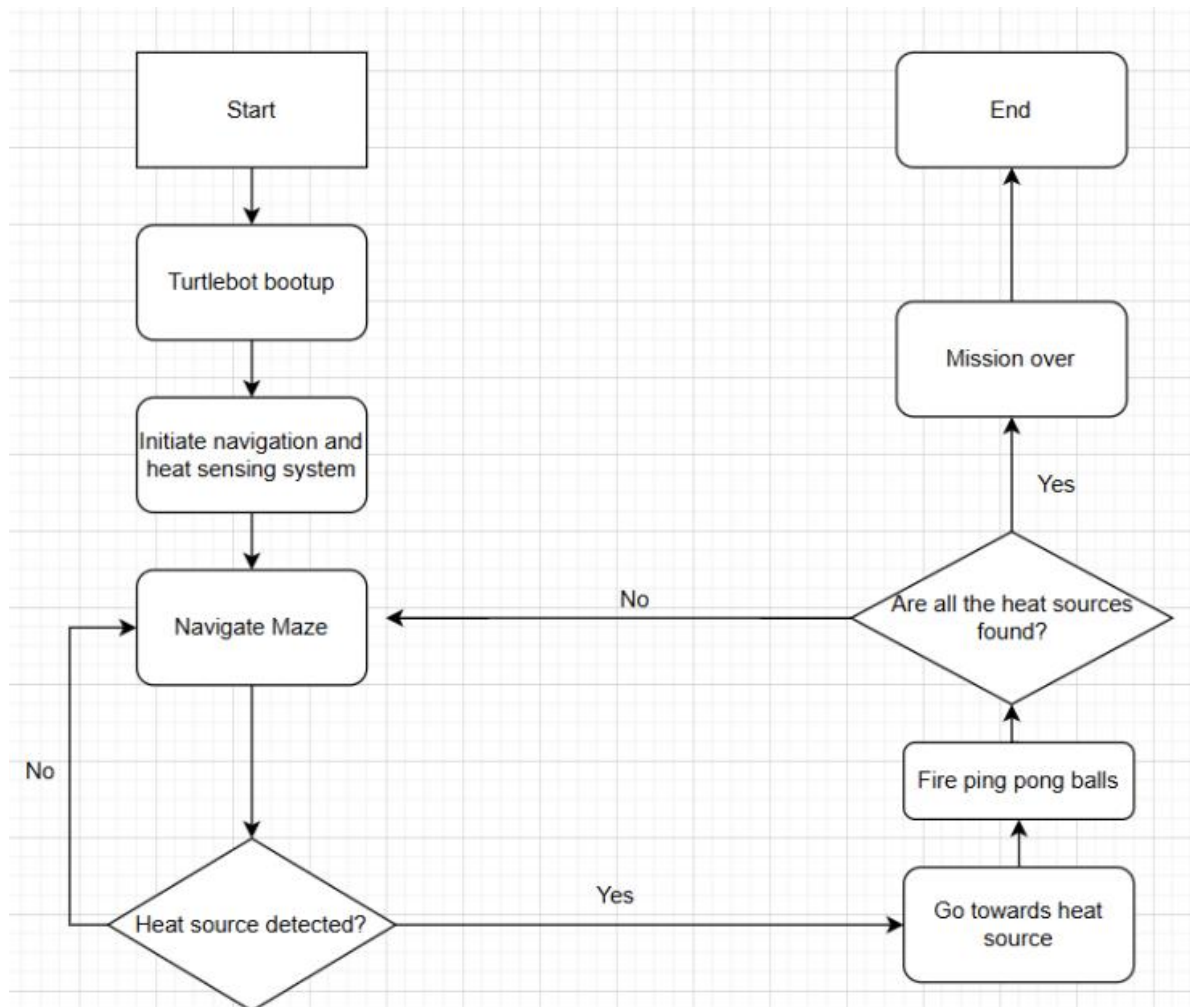


Figure 2: General Con-Ops Overview

Stakeholder Requirements	Project Deliverables
Traverse map autonomously	Implement mapping techniques to generate real time map of maze
Avoid obstacles	Develop capability for obstacle avoidance and navigation
Detect Heat source	Detect heat readings and trigger launcher when above threshold
Fire Flares above 1m	Generate enough power to fire ball above 1m
Fire at interval	Incorporate firing timing at 2-4-2 intervals

Stakeholder Requirements	Functional Requirements
Traverse map autonomously	Using SLAM incorporate frontier exploration and path planning algorithm to continuously update and refine map during exploration
Avoid obstacles	Utilise sensors and lidar to detect obstacles and navigate around them

Detect Heat source	Using heat sensor set threshold and create code such that when threshold is hit, launch mechanism triggers
Fire Flares above 1m	Use flywheel mechanism ,rack and pinion system to load balls into flywheel mechanism
Fire at interval	Using servo adjust speed at which balls are loaded into the flywheel

Constraints	Description
Cost	80 Dollar budget
Power	Operate within constraints of power source
Sensor	Limited by cost and availability
Processing power and memory	Limited due to Rpi, affects algorithm efficiency
Size	Fit within walls and passages of the maze