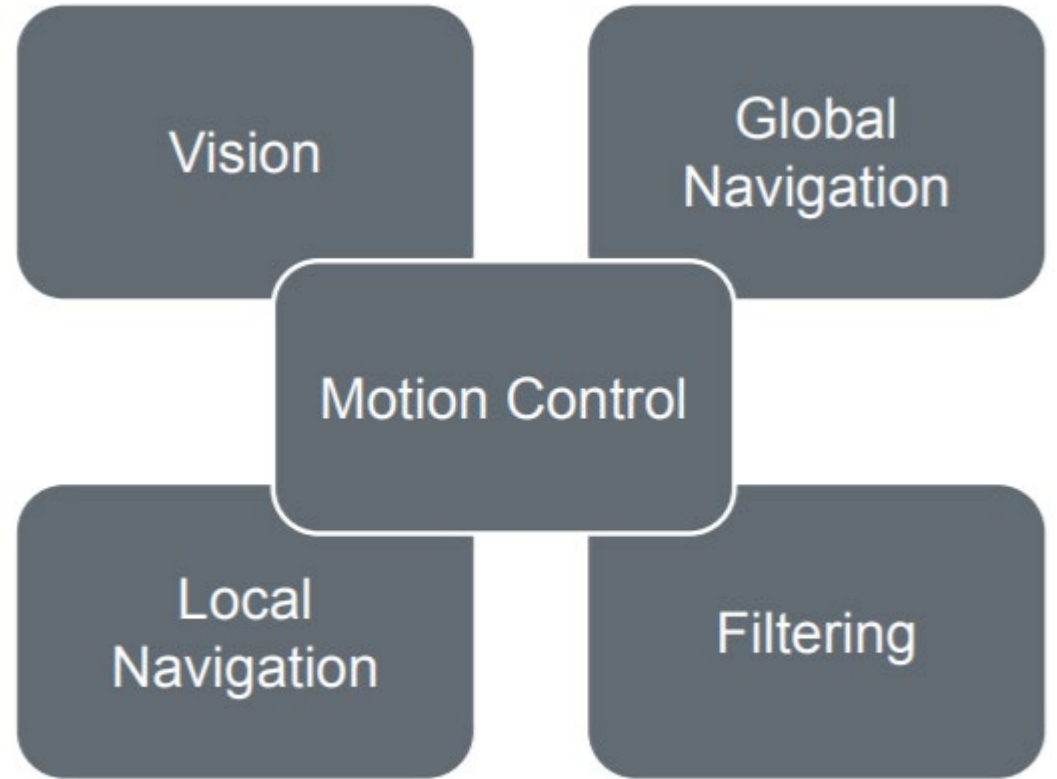


Autonomous Mobile Robot

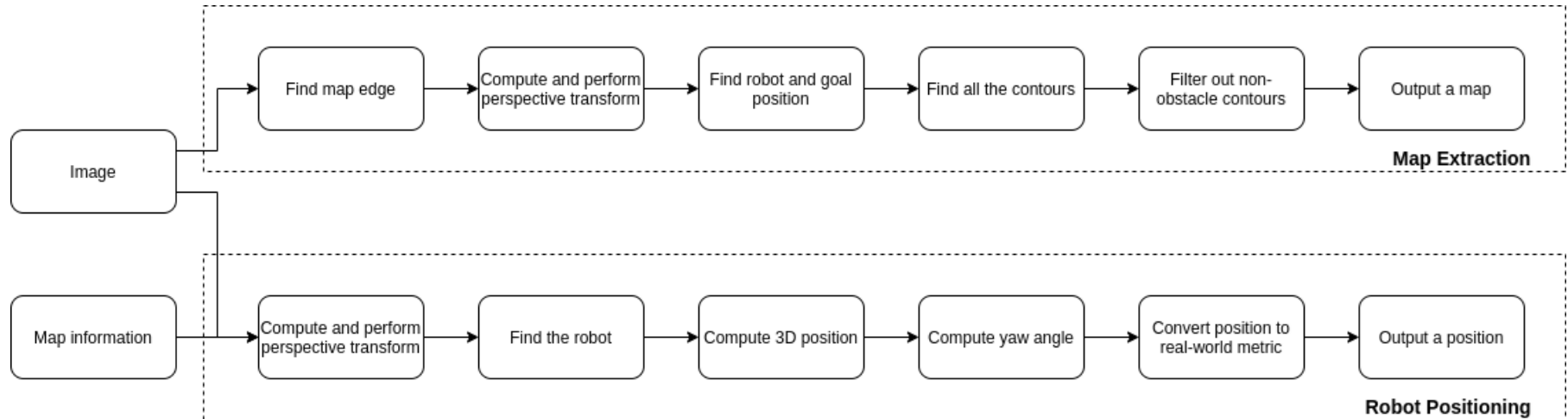
Project Overview



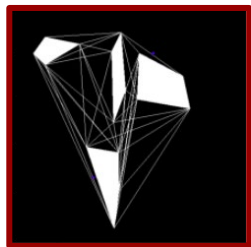
Components that are required for the project

Vision Module

- Take an image from the camera
- Use OpenCV framework to process
- Provide the map
- Provide the robot position estimate



Global Path



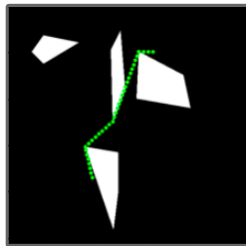
Visibility Graph

Translates the given start node, end node, and set of polygons to a visibility graph and a corresponding adjacency matrix



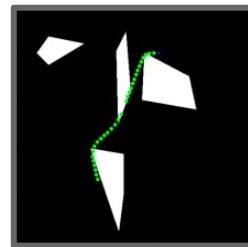
Dijkstra's Algorithm

Computes the shortest path linking the start and end node and returns a list of nodes that would lead from start to end in an optimal way



Discretization

Subdivides the straight lines joining the selected graph nodes into sets of waypoints separate from one another by a hyperparameter distance h



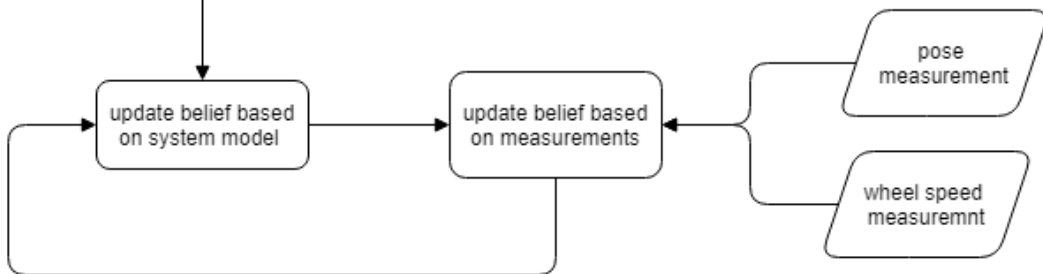
Smoothing

Extracts portions of the path that correspond to a transition in heading. Converts those portion to a smooth curve and attaches them back to the untouched initial sections

Localisation

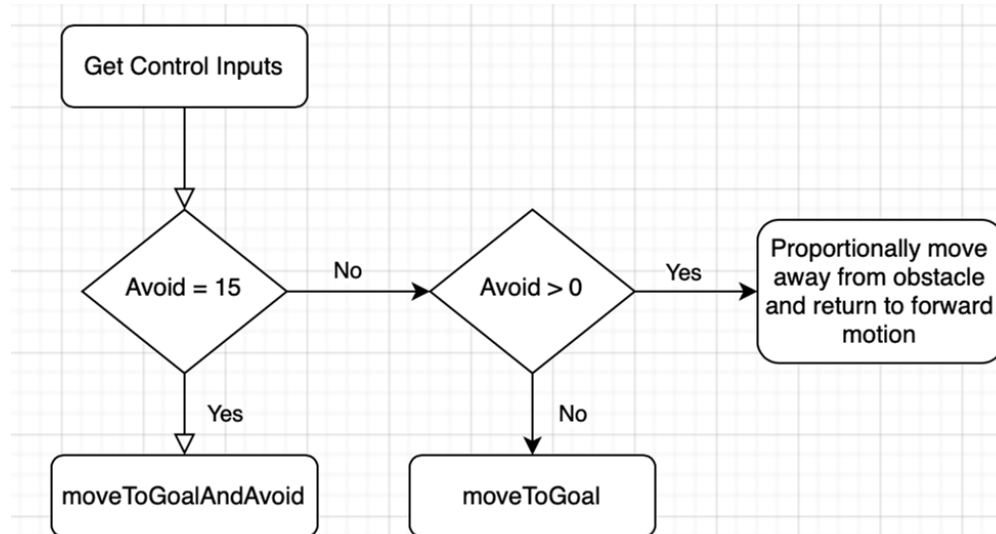
- goal → combine uncertain measurements with uncertain motion model into accurate belief on the current state
- how → Unscented Kalman Filter
 - (approx) gaussian measurements
 - non-linear system (differential drive)
 - less computationally intensive than particle filter

$$\begin{cases} x' = x + v_{lin} \cos(\theta + v'_\theta dt/2) dt \\ y' = y + v_{lin} \sin(\theta + v'_\theta dt/2) dt \\ \theta' = \theta + v'_\theta dt \\ v'_{lin} = \frac{(v_L + v_R)}{2} \\ v'_\theta = \frac{(v_R - v_L)}{d} \end{cases}$$



Motion Control

- Use current pose, position of next waypoint, and sensor measurements to determine the reference heading angle
- Compute heading error
- PID Control to obtain motor inputs



Main control Loop

