1 Exploration of an unknown environment using the Generalized Voronoi Graph

The goal of this assignment is to control a mobile robot and guide it through the Generalized Voronoi Graph (GVG). For an arbitrary environment the GVG is a graph for which the edges represent locations in free space equidistant to two obstacles and the vertices (meetpoints) are locations which are equidistant to three or more obstacles, which are also the locations where two or more edges meet. You would write a program in C++ interfacing with the Stage Simulation package using the Player libraries. For any of the provided environments, your program should guide the robot to access the GVG and then to start following a GVG edge. When the robot reaches a meetpoint selects randomly a different edge and continues to follow it. The robot uses its laser sensor for obstacle detection.

First implement and test independently the following functions:

- **AccessGVG**: this function moves the robot away from the closest obstacle until the robot is equidistant from two obstacles. In order to compensate for the blind range of the sensor (behind the robot) keep in memory the discovered closest obstacle.
- **OrientAlongEdge**: rotate the robot to face along the Voronoi edge.
- **FollowEdge**: this function guides the robot on a path equidistant to two obstacles. Following a Voronoi edge can be done by estimating the two closest obstacles, (not just points) find the mid-point, which should be used to calculate the displacement $d$. For orientation correction use an angle perpendicular to the line that connects the two closest obstacles. Filter the laser points using the distance to the closest obstacle plus $\epsilon$ in order to identify distinct obstacles.
- **DetectMeetPoint**: this function detects when the robot approaches a location which is equidistant to more than two obstacles. Then it returns the orientation of the edges that leave from this meetpoint.
- **SelectEdge**: Randomly select an edge.
• DetectEdgeEnd: when the robot is following an edge and the closest distance drops below a
threshold, then this edge can be terminated with a meetpoint (vertex) of degree 1.

Create a program that performs GVG exploration of an unknown environment using the above
described functions. Document your efforts, discuss difficulties and potential improvements. Present
results from the cave.cfg, autolab.cfg, and hospital1.cfg configuration files.