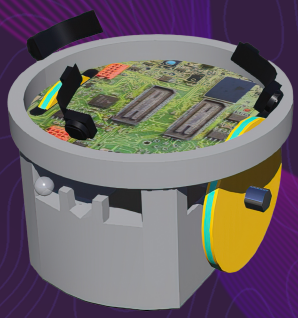
"HTL"

RoboCup Eindhoven 2024

RoboCup Junior



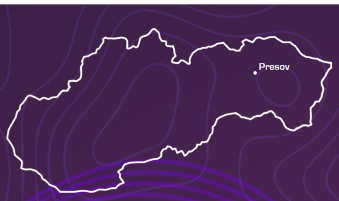
Team :

Team's name : "HTL"

League : Rescue Simulation

Country: Slovakia

City: Presov



Roles:

Adrian Pala (tester)is the most experienced member of our team. Last year, he won the second prize in the Slovak round of RoboCup OnStage competition and advanced to the European level. Also, he participated in some minor competitions.
Patrik Hric (debugger) has participated in minor competitions.
Tomas Pribula (movement) is an expert in programming, he also develops software for companies and participates in minor competitions.
Marek Bohac (wall tokens detection) has participated in minor competitions.

Program :

Programming language:

Python (we tried C++ before but we gave up because it was too complicated to run the program ^^')

Libraries:

OpenCV, NumPy, ScikitImage

Algorithms:

Breadth First Search Algorithm(BFS)
A* Search Algorithm

Strategy:

Each sensor was placed systematically to make use of the most of their functionality. Instead of distance sensor, we used LiDAR as it's function is much more usefull and allows 360° field of detection instead of just 1 direction and has no trouble identyfing curved walls, calculating distances and sampling angles.

Main loop :

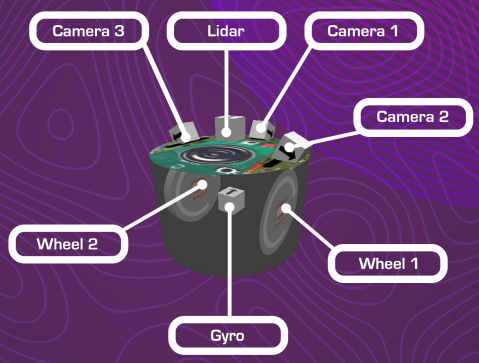
Members :

Adrian Pala

Patrik Hric

Tomas Pribula

Marek Bohac



Design :

Strategy:

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Sensors:

LiDAR:
Detects objects and obstacles surrounding the robot. It's located on top center of the robot taking full advantage of it's 360° field of detection.

GPS:
Detects robot's coordinates, navigates it during exploration and reorientates it in case it gets reseted. Located in the center of the robot.

Gyroscope:
Measures robot's orientation to make sure it advances straight and can rotate accurately. It is located in the center of the robot to make sure the data are as accurate as possible.

Camera (3x): Recognition of Wall tokens and floor colors taking advantage of it's color distinction function.

Detection :

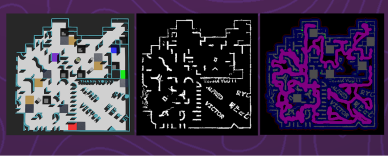
Instead of color sensors, we decided to implement a recognition/detection method using camera and it's color distinction function using color filters robot identifies wall tokens based on their color and shape.
Robot constantly scans his surroundings using camera and once he detects Wall token he uses Contour detection(OpenCV library) and isolates symbols for analysis differentiating victims from hazards.

The cropped image is then divided into three sectors. By contrasting proportion of white to black pixels in each sector, robot can identify specific victim type. When identyfiing hazard signs robot also divides the image into three sectors and calculates average color between the sectors. Based on that he can identify specific type of hazard.

Thanks to a slight inclination of cameras they can also see the floor. Using cameras color filters robot scans every tile's color and identifies wether it's a checkpoint,black hole,zone-to-zone passage or just normal tile.

Mapping :

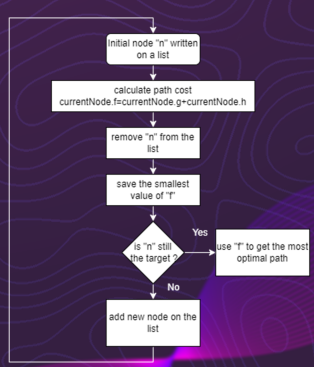
Every movement during the map exploration is stored in a resizable NumPy array. Robot then crosses the resizable array with information collected during the exploration and forms a grid with all revelant information. When the simulation stops, grid is converted to a matrix.



Navigation :

We sample data from LiDar to filter out Acessible and not acessible points of movement and to place nodes. After that we decided to implement A* algorithm to calculate the most optimal path by which robot can reach the node and BFS algorithm to check for not explored areas, in which the next nodes will be placed.

A* algorithm :



BFS algorithm :