Development of an agent for a robot that solves labyrinths PathFinder

Intelligent and Mobile Robotics – Final Project

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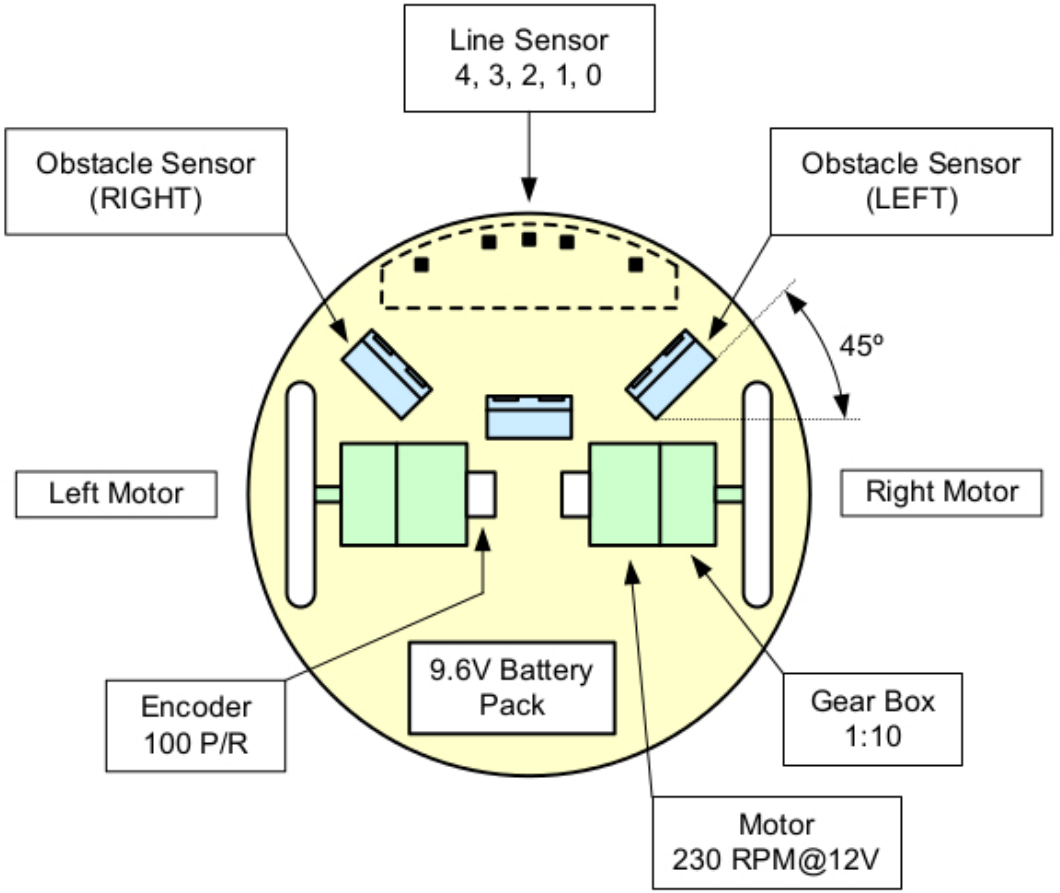
Intro

- C
- Basic text editor
- Robot
- Pcompile
- PathFinder



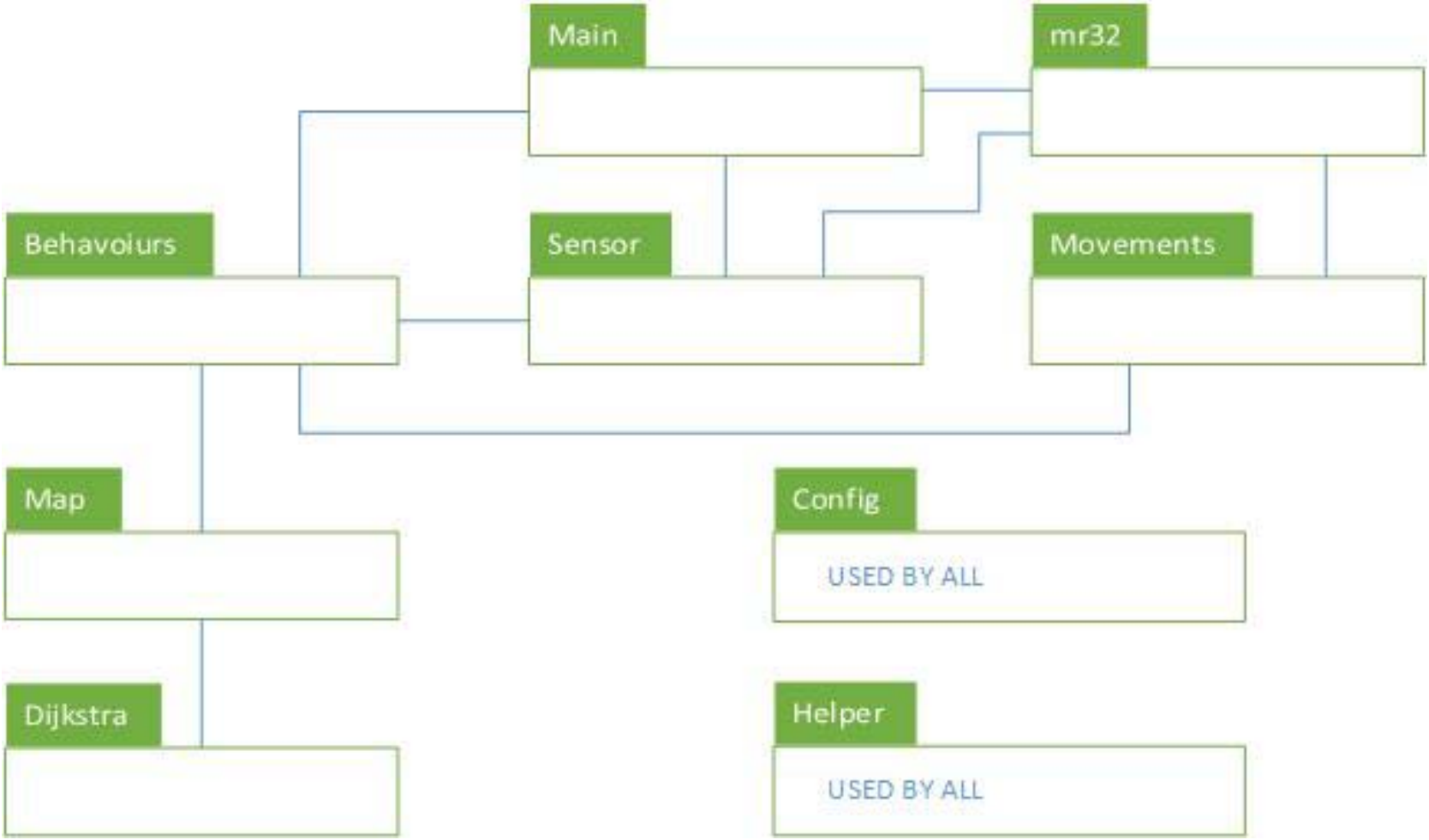
Project 7 – PathFinder - G9

- **General Description:**
- to implement a robotic agent that solves labyrinths
- **Challenge:**
- Use a DETI robot to solve a labyrinth defined in an area of 3,6x3,6m; the areas of departure and arrival are marked in black (on a white background). The labyrinth is built on a cell grid of 45cmx45cm.
- The robot must explore the labyrinth until it finds the area of arrival, and then return to the departure through the shortest path, using the knowledge acquired in the exploration phase.
- No beacons are used.

Basic concept

- Abstracting the robot
  1. Movements
  2. Sensors
- Subsumption Architecture (More or less)
  - Prioritized list of behaviors (dinamic)
- Build upon solution from 2nd project
- Behaviors
- Mapping and retriving shortest path
- Sensor filtering
- Movement buffering
- …

Solution architecure



Sensor module

Feature list:

1. Compass
2. Circular buffer (5)
3. Normalization
4. Error compensation
5. Filtering readings
    1. Weighted average
    2. Median

Movements module

Feature list

1. Buffered movements
2. Many types of movements
    1. Forward
    2. Rotate
    3. Move in curve
    4. …

Map module

Feature list

1. MapField (Node) and MapConnection(Vertex)
2. Dijkstra's search algorithm
3. Checking for existing fields
4. Printing out map
5. Flexibe (number os connections, fields…)

Behaviours

Behaviour list

1. StopAtBeaconArea
2. AvoidCollision
3. StopAtStartingPoint
4. FollowPath
5. ReturnHome
6. ExploreLabyrinth
7. CorrectPosition

Behaviours

Explore labyrinth sub behaviours:

1. Move to next point
    1. Check if fields on sides are occupied
    2. Go to next behavoiur
2. Find next unexplored area
    1. If area isn't here set shortest path to unexplored area
    2. Go to next behaviour
3. Discover/Evaluate an unexplored field
    1. Get accurate readings
    2. Determine if field is free or occupied
        1. Occcupied – correct position and go to previous b.
        2. Free – set field as next field and go to first b.

Behaviours

Correct position:

1. Adjust angle and check if a wall is in front
2. Get sensor readings
3. Check distance from wall
4. Robot is to far or to close to the wall
    1. Report error offset to the sensor module
    2. Move to new position

Initial and return priority lists

Priority lists:

1. StopAtBeaconArea
2. AvoidCollision
3. CorrectPosition
4. FollowPath
5. ExploreLabyrinth

1. StopAtStartingPoint
2. AvoidCollision
3. CorrectPosition
4. FollowPath
5. ReturnHome

Workflow

- BasicWorkflow:

1. Initialisation
2. Start loop
    1. Refreshing sensor readings
    2. Testing behaviors
    3. Execution of behavior with highest priority
        1. Updating map
    4. Check if finished
3. End

Resulting behaviour

1. Initialisation
2. Robot moves from field to field
3. Checks is surounding fields are free or occupied
4. Updates the Map
5. Travels to unexplored areas by shortest path
6. When beacon is found - setup return settings
7. Calculate shortest path
8. Return to starting point
9. Print out Map
10. Finished

Development difficulties

1. Programming in C
2. Noisy sensor readings
3. Integrating the compass
4. Testing and changing the behaviour
5. Accumulation of error on the position readings
6. More reliable behaviour and readings = slower movement

Results and Limitation

Results:

- Good results
- Flexible
- Mapping
- Compensation for error
- Optimizations
- Code Documentation (Doxygen style)

Limitations

- Memory
- Sensor readings
  - Noise
  - Error accumulation
  - Speed