Find a light source with an e-puck robot

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Introduction

Goal:
Find a light source with the two-wheeled e-puck robot while avoiding obstacles on the way
Experiments

• **First phase:**
  Virtual simulation environment Webots
  – Basic behavior: obstacle avoidance and light following
  – Special problems: more complex obstacles

• **Second phase:** Transfer to real e-puck
Results

Braitenberg control architecture:

\[ speed_{left} = \sum_{i=0}^{n} \alpha_{left,i} \left(1 - \frac{value_i}{range}\right) \]

Range_light: 0 (much light) – 4095 (little light)

Range_prox: 0 (far) – 3800 (close)
Obstacle detection

Condition:
1 distance value above 300
Dead end detection

Condition:
4 front distance values above 300
DEAD END

Behavior:
Speed_left = -1000
Speed_right = 1000
Orientation towards wall

Condition:
Sensor 2 or 5 above 1500

Behavior:
Braitenberg-set «Wall turning»
WALL TURNING

Condition:
Sensor 2 or 5 above 1500

Behavior: Braitenberg-set «Wall turning»
WALL FOLLOWING

Behavior:
Braitenberg-set
«Wall following»

Diagram:
- Obstacle nearby?
  - No → LIGHT FOLLOWING
  - Yes → Dead end?
    - No → WALL TURNING
    - Yes → WALL FOLLOWING
- Aligned to wall?
  - No → WALL TURNING
  - Yes → WALL FOLLOWING
- Wall corner?
  - Yes → Rotate to be aligned again (WALL CORNER)
  - No → Go straight forward for some iterations (WALL END)
- Wall ends?
  - Yes → Go straight forward for some iterations (WALL END)

Introduction - Experiments - Results - Conclusion
## WALL FOLLOWING

### Sensor Readings

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Left</th>
<th>Right</th>
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<tbody>
<tr>
<td>0</td>
<td>80</td>
<td>-120</td>
</tr>
<tr>
<td>1</td>
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<td>50</td>
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<tr>
<td>7</td>
<td>-120</td>
<td>80</td>
</tr>
</tbody>
</table>

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**Introduction** - **Experiments** - **Results** - **Conclusion**
Wall corner detection

Condition:
Sum of two front distance sensors > 600

Behavior:
Braitenberg-Set «Wall corner»
WALL CORNER

Condition:
Sum of two front distance sensors > 600

Behavior:
Braitenberg-Set «Wall corner»
Wall end detection

Condition:
Front sensor < 300
Sensor 2 or 5 > 1500
Behavior:
Go straight forward for 8 iterations before turning

- Obstacle nearby?
  - No
  - LIGHT FOLLOWING
  - Dead end?
    - No
    - WALL TURNING
    - Yes
    - WALL FOLLOWING
      - Wall corner?
        - Yes
        - Rotate to be aligned again (WALL CORNER)
        - No
        - Dead end?
          - Yes
          - DEAD END
          - No
          - WALL FOLLOWING
            - Wall ends?
              - Yes
              - Go straight forward for some iterations (WALL END)

Introduction - Experiments - Results - Conclusion
LIGHT FOLLOWING

Condition:
All distance values below 300

Behavior:
Braitenberg-set
«Light following»
Results

Modifications for the real world

– Distance measurements depend on properties of obstacle
– Light measurements depend on light source
– Reported light intensities smaller than in Webots
– Microcontroller on e-puck slower than PC
– Role of noise
Results
Conclusion

• Problems requiring further refining
  – Behavior in dead ends
  – Stopping at obstacle corners
  – Wall following only if wall on same side as light
Thank you for your attention!
References

• http://www.cyberbotics.com/dvd/common/doc/webots/guide/section7.5.html, 01.06.2015.