SIS
Road Sign Recognition Project

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Plan

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Introduction

• Programming e-puck robot to follow road signs
• Image processing through Fast Fourier Transform
• Movement through obstacle avoidance
Road Signs

Turn left

Turn right

Turn around
FFT Theory

FFT algorithm: convert data from time domain (smoothie) into frequency domain (ingredients in the smoothie)
FFT on columns of *turn left* sign
FFT on rows of *turn left* sign
Method

- Number of peaks is very distinct
- **Counting peaks**
- Introducing *cut-off threshold*
- Robust to environmental constraints
Step 1 - Matlab

- Do FFT on rows and columns
- Find main peak
- Shift by 15 to left and right
- Count peaks > threshold
- Take a decision
Constraints in Matlab

• Noise-free pictures
• Tries with other pictures
• Strategy worked well

➢ Ready for Webots!
Step 2 - Webots

- Start with the same strategy
- First memory problems
- First noise problems, still works fine
- Overall acceptable results at the end
Constraints in Webots

- Functions used in webots don’t work on the real epuck
- Still only a simulation
- Works in webots != works on epuck
- Overall not as useful as it could be
Step 3 – E-puck

- Obstacle avoidance

*Braitenberg vehicle*
Step 3 – E-puck

- Obstacle avoidance

*IR sensors of the E-puck robot*
Step 3 – E-puck

- Road sign recognition

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// Decisions

if there are very few peaks
    turn around
else if there is the same number of peaks in both FFT's
    Do it again
else if there is a big number of peaks in both FFT's
    Do it again
else if the number of peaks in both FFT's are too similar
    Do it again
else if there are more peaks in rows than columns
    Go right
else if there are more peaks in columns than rows
    Go left
else
    Do it again
end

Pseudocode for taking decision
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Constraints with e-puck

- Real-world -> Noise
- Real-world -> Limitation of memory
  - No memory management
  - Small amount of RAM
Results

• Good success rate as we will see after
• Method worked well
• Still hesitates fairly often but finds its way in the end
Experiments - 1

Road sign of 9cm Height
Experiments - 2

Road Sign Size = 4.5 cm

Road sign of 4.5 cm Height
Experiments - 3

Road sign of 3 cm Height
Experiments - 4

Low Lightening Conditions in the Hallway
Experiments - 5

Window Frame on Sun Side

High Lightening Conditions Outside
Conclusion

- Exit the maze using different types of sensor
- Project allowed to put together our knowledge
- We had to deal with memory and noise issues when going from the simulation to real world
- In general the results were satisfying except with low light condition $\rightarrow$ filtering
References

- SIS Course Week 7: “Introduction to Embedded Systems – Computing, Sensing, Communicating”, M. Alcherio
- Olivier Michel, “Cyberbotics Ltd.”, Webots: Professional Mobile Robot Simulation, Swiss Federal Institute of Technology in Lausanne
- Assignment Lab07 SIS course 16-17 and its correction
- Assignment Lab08 SIS course 16-17 and its correction
- Assignment Lab09 SIS course 16-17: for the printing and LED commands