Using Omnidirectional Vision within the Spatial Semantic Hierarchy

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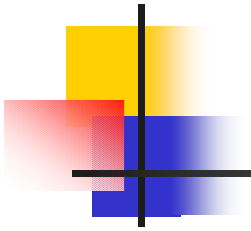


Introduction

Robot's task:

Building a topological map of an unknown environment

Sensor:

Omnidirectional vision system

Work's aim:

Prove effectiveness of omnidirectional sensors for Spatial Semantic Hierarchy

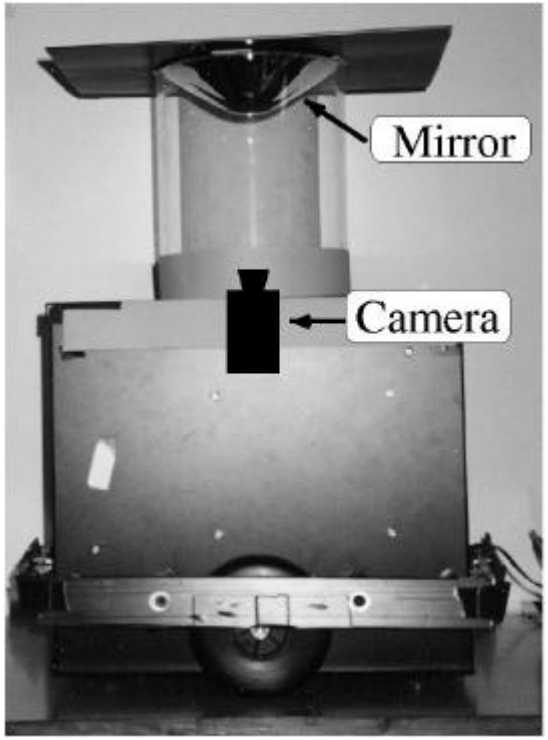
Spatial Semantic Hierarchy...

... A model for the human knowledge of large spaces

Layers:

- Sensory Level
- Control Level
- Causal Level
- Topological Level
- Metrical Level

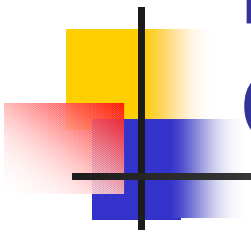
Omnidirectional Camera



Composed of:

- Standard Colour Camera
- Convex Mirror
- Perspex Cylinder

Pros e Cons of Omnidirectional Vision



Advantages

- Wide field of view
- High speed
- Vertical Lines
- Rotational Invariance

Disadvantages

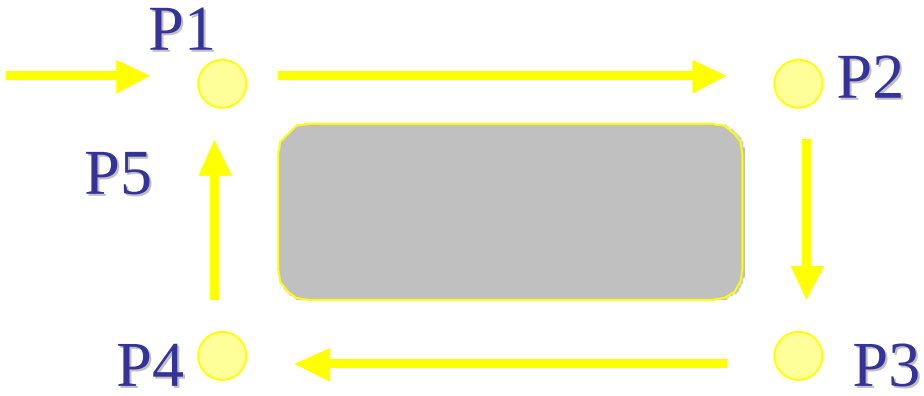
- Low Resolution
- Distortions
- Low readability

Omnidir. Vision and SSH

View ⟺ Omnidirectional image

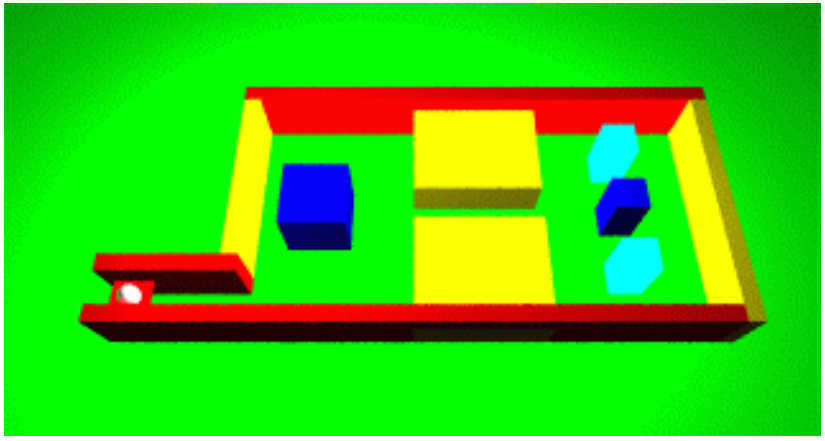
This simplifies data interpretation:

- Discriminate b/t "*turns*" and "*travels*"
- Simplify "Exploring around the block"



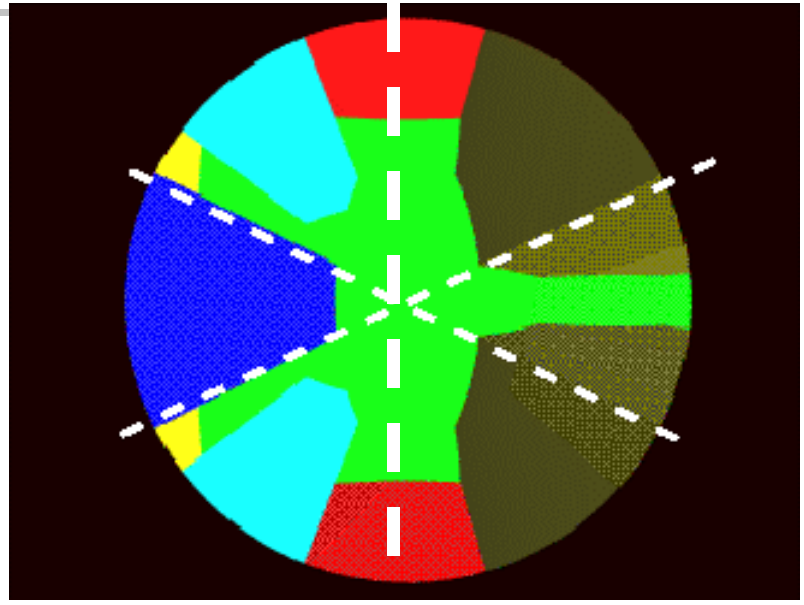
Assumptions

- Man-made environment
- Floor flat and horizontal
- Wall and objects surfaces are vertical
- Static objects
- Constant Lighting
- Robot translates or rotates
- No encoders



The virtual environment

Features and Events



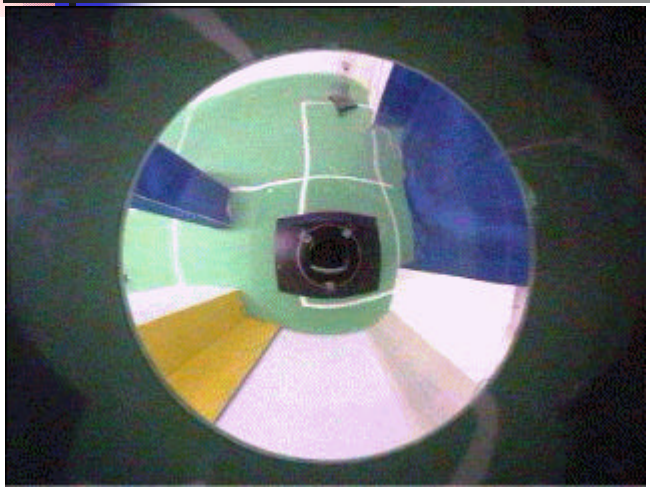
Feature:

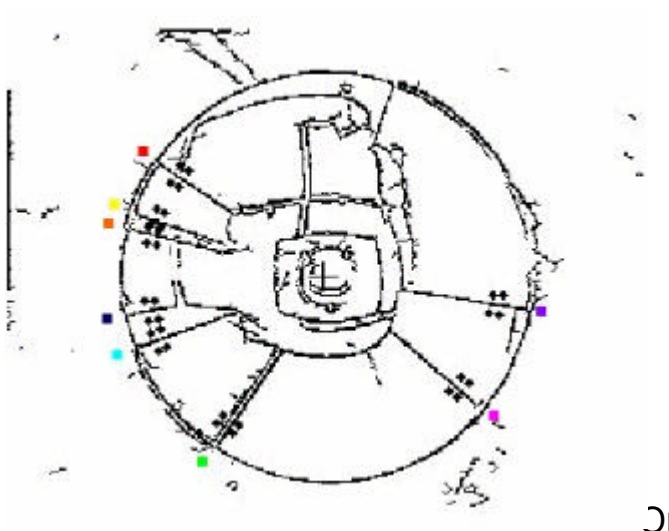
- Vertical Edges

Events:

- A new edge
- An edge disappears
- Two edges 180° apart
- Two pairs of edges 180° apart

Experiments





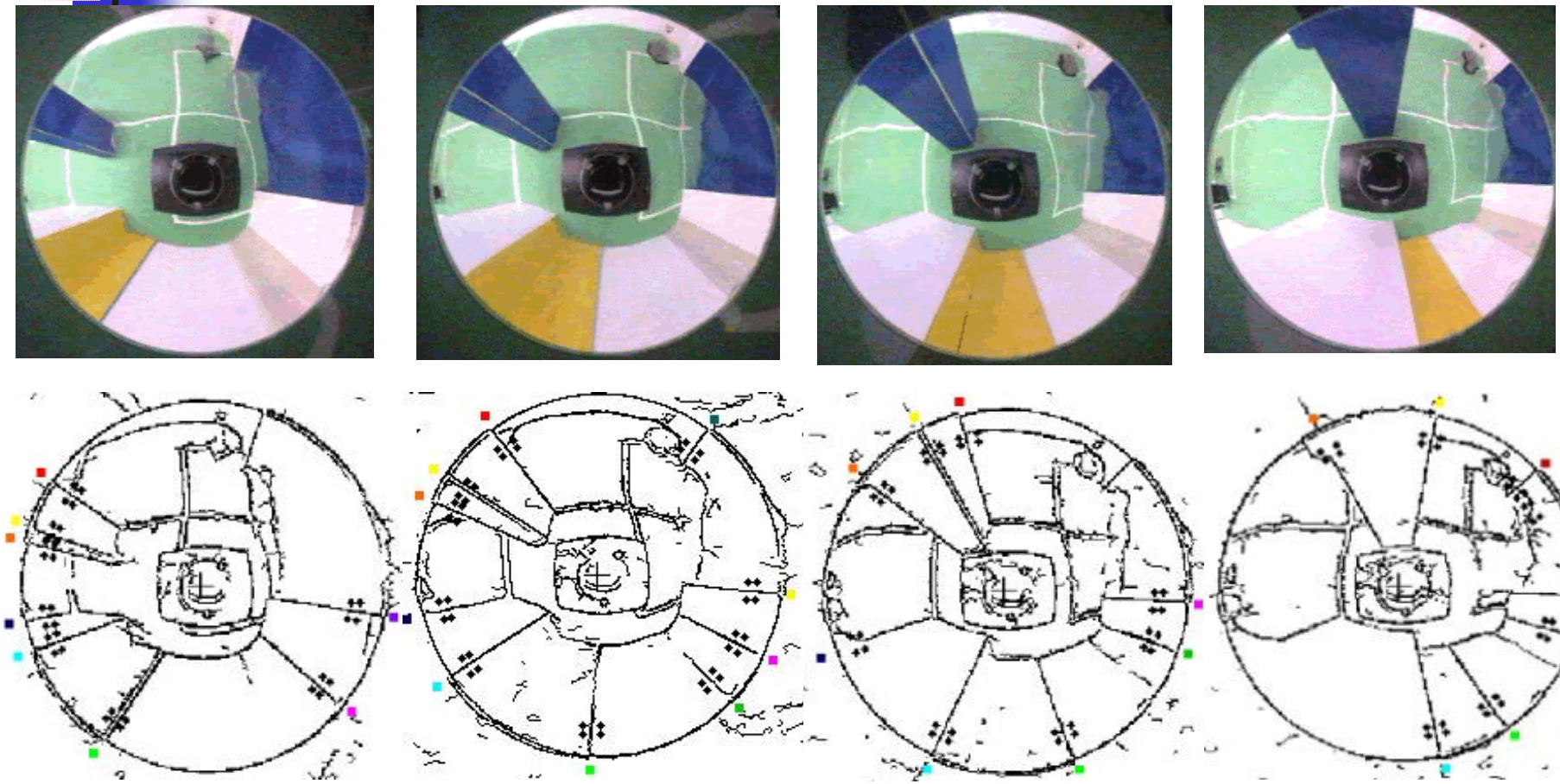
Tasks of Caboto:

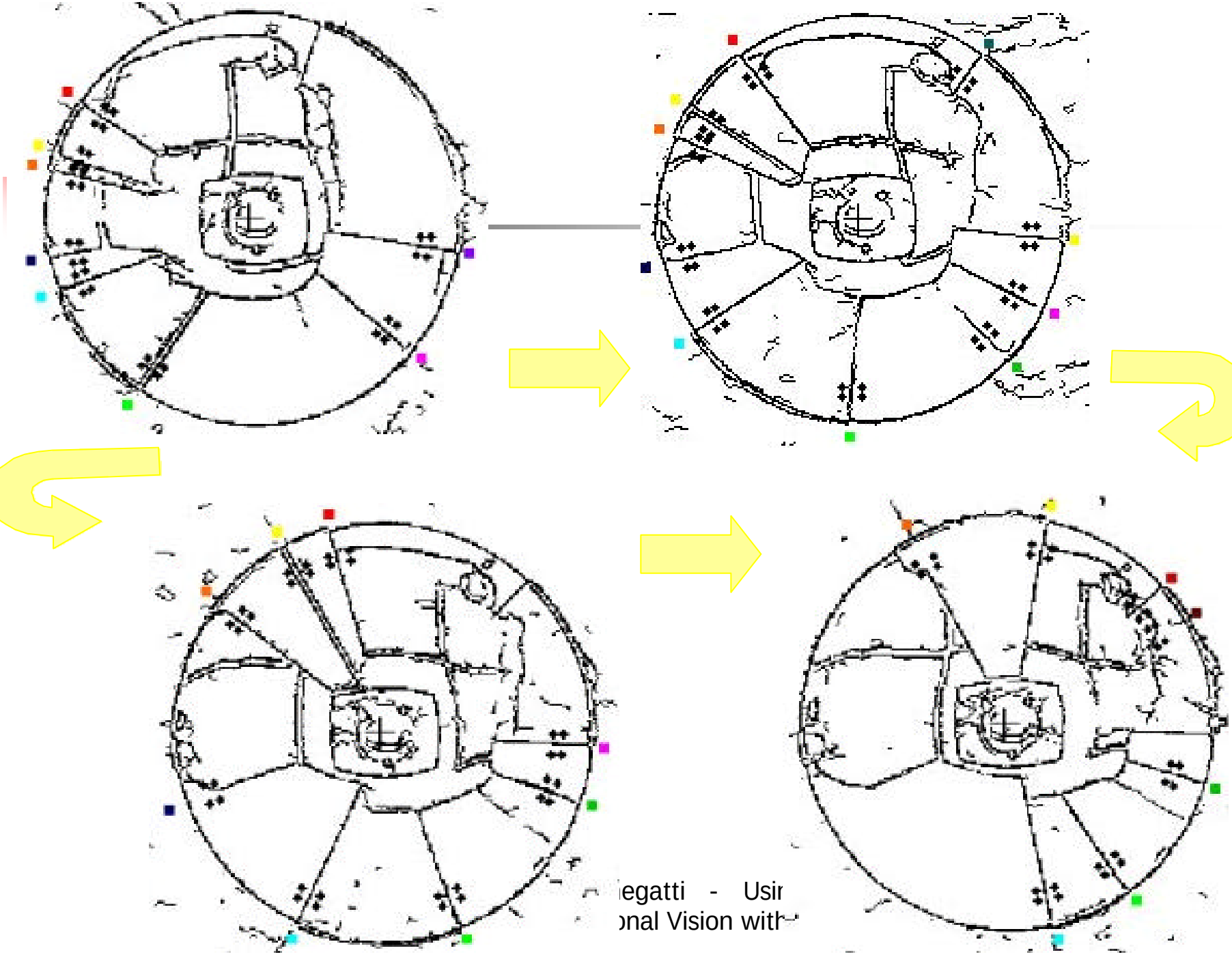
- Navigation;
- Map building;

Techniques:

- Edge detection;
- Colour matching;

Caboto's Images





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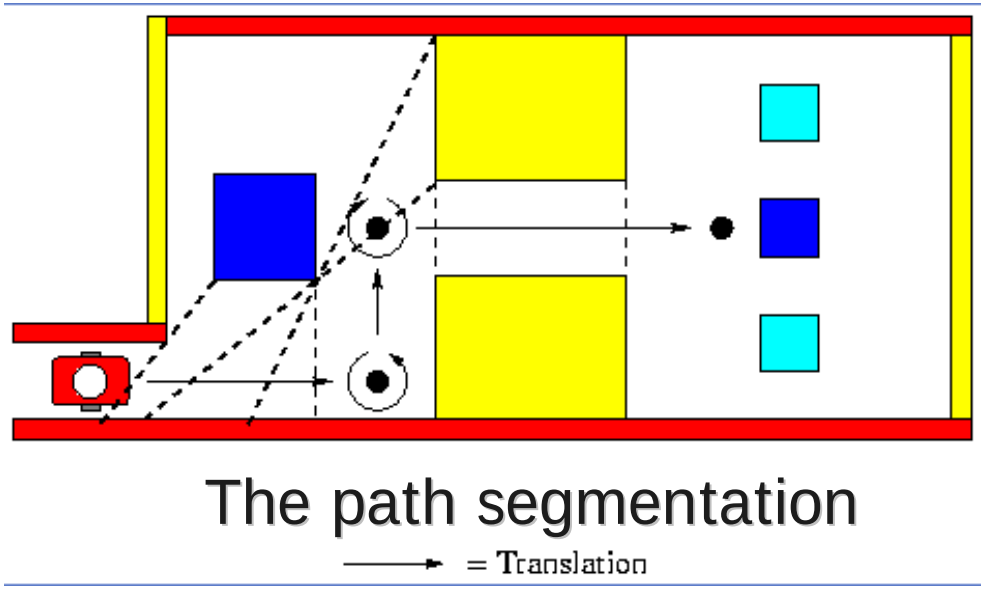
Results

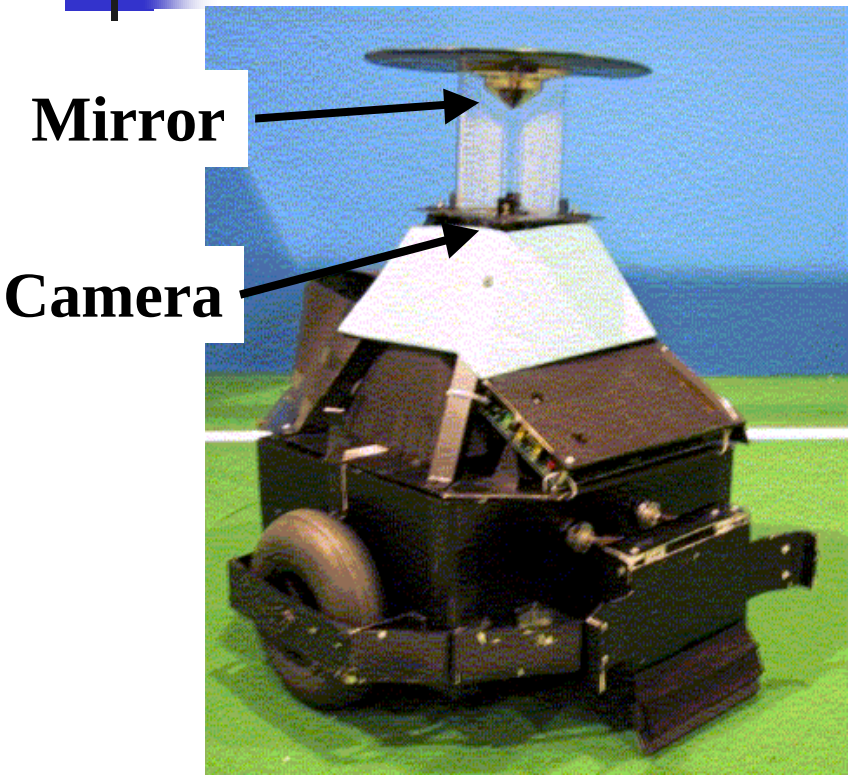
- Correct tracking of edges
- Recognition of actions
- Calculation of the turn angle



The path segmentation

Future Works

New Mobile Robot Base

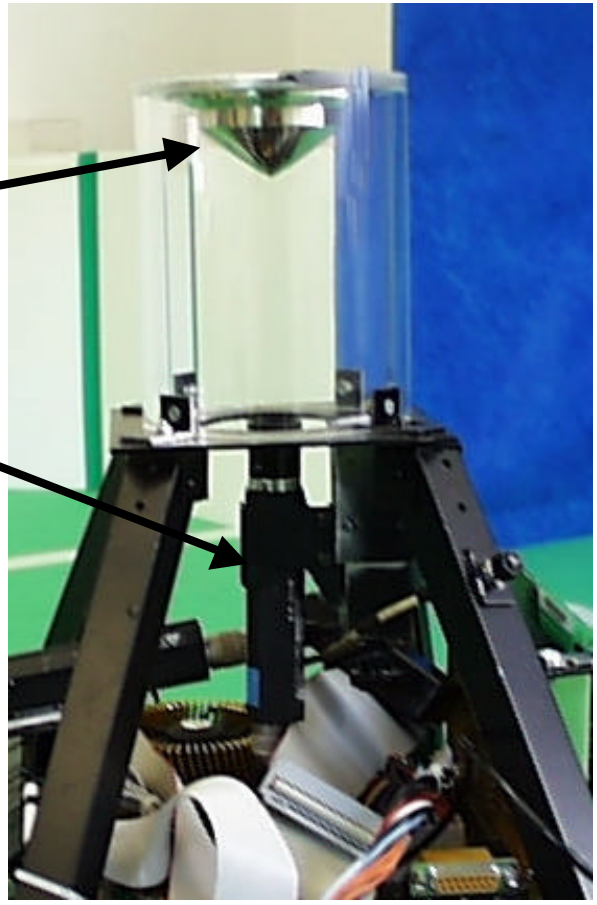


Characteristics:

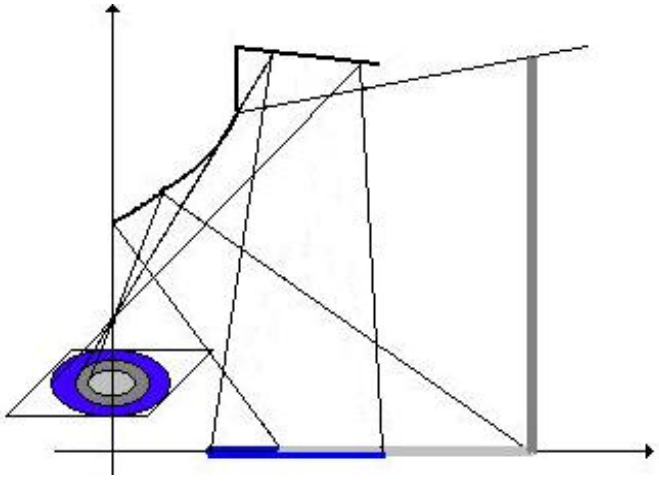
- *Chassis shaped for omnidirectional vision*
- *Mirror* **profile** *designed for the robot's* **task**

Future Works

New Omnidirectional Sensor



- Mirror with **custom** profile
- Maximise resolution in RO



Future Works

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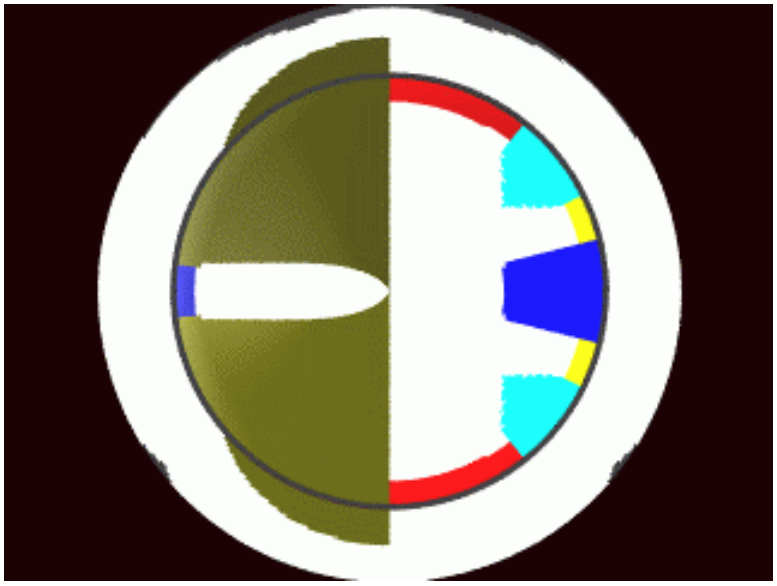
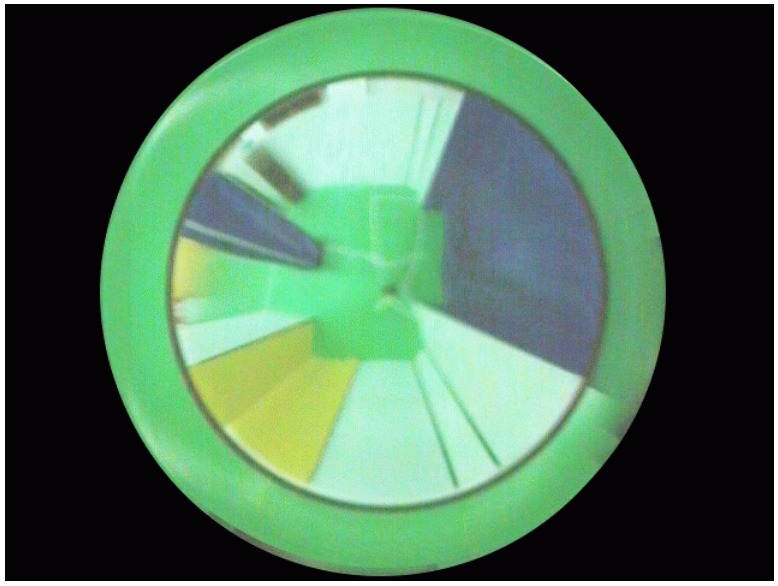


Simulated View



Actual View

Conclusion

- Omnidirectional vision sensor is a **good sensor** for map building with SSH
- **Egomotion** of the robot estimated without active vision
- The use of a **mirror designed for this application** will improve the system