A Visual Navigation Assistant for Humans

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Problem Statement

We wish to provide navigation assistance to humans in GPS-denied environments.

Why is it hard?

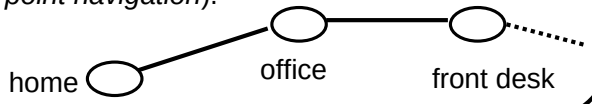
- Inertial sensors/odometry drift over time
- Real-world environments are cluttered & noisy
- Environment is unknown (*no training*)
- *Visual aliasing*: different places look the same

Why is it important?

- Assistive technology to the visually impaired
- Soldiers in the field
- Guided tours of museums/public places

Typical Scenario

- A user explores an unknown environment.
- At any point, the system provides guidance to come back to the starting point (*retrace*) or to go from any previously seen place to another (*point-to-point navigation*).



Our Approach

System Input ⋯⋯▶ **System Ouptut**

A single training video sequence (same for all explorations)
A live video sequence of the exploration

Human-oriented navigation assistance
Sequence of *coarse directions* (turn left, go right, etc.)

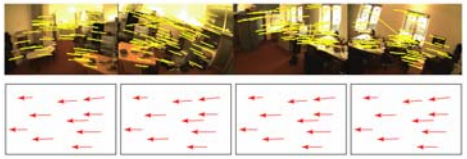
Topological Mapping

Nodes: places of interest (*breadcrumbs*)
Edges: physical paths between nodes

- Built automatically during exploration
- Used by the system to provide guidance

Rotation guidance with no camera calibration

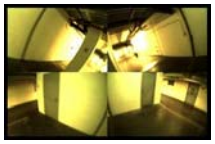
- System learns the correlation between user motion and motion field



Contributions

- End-to-end, real-time mobile system
- Novel algorithm for rotation guidance with no camera calibration
- New approach to *visual loop closure* using visual fates of features (work in progress)

Datasets



Name	Duration	Path length	Frame rate	# frames	# nodes
INDOOR	45 min	2.5 km	4 Hz	11,000	280
OUTDOOR	12 min	1 km	4 Hz	2,900	43

Future Work

- Global localization
- Loop closure
- Augmented Reality Apps

References

Olivier Koch, Seth Teller, *A Self-Calibrating, Vision-based Calibration Assistant*, ECCV Workshop on Computer Vision Applications for the Visually Impaired, October 2008, Marseille, France. **http://rvsn.csail.mit.edu/navguide**

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