Robotic Navigation and Exploration

Week 1: Introduction

Min-Chun Hu anitahu@cs.nthu.edu.tw
CS, NTHU / CSIE, NCKU

!!! Notice !!!

- 若有任何身體不適的感冒症狀，請勿出席課程
  - 將提供**Youtube課程影片**供在家自主學習
    - 清大上課版: https://ppt.cc/ffwHOx
    - 電腦版: https://ppt.cc/fGKy9x
- For NTHU
  - 為落實疫情防範與個案接觸者追蹤，將採**固定座位**上課
  - 每週上課前，請於門口座位表簽到，並按座位表入座，未簽到者，請勿進入教室
  - 因自走車數量有限，僅開放10個加簽名額
  - 若需旁聽，請務必向助教登記，以利安排座位圖

Outline

- Syllabus
- Overview of Mobile Robot

Syllabus

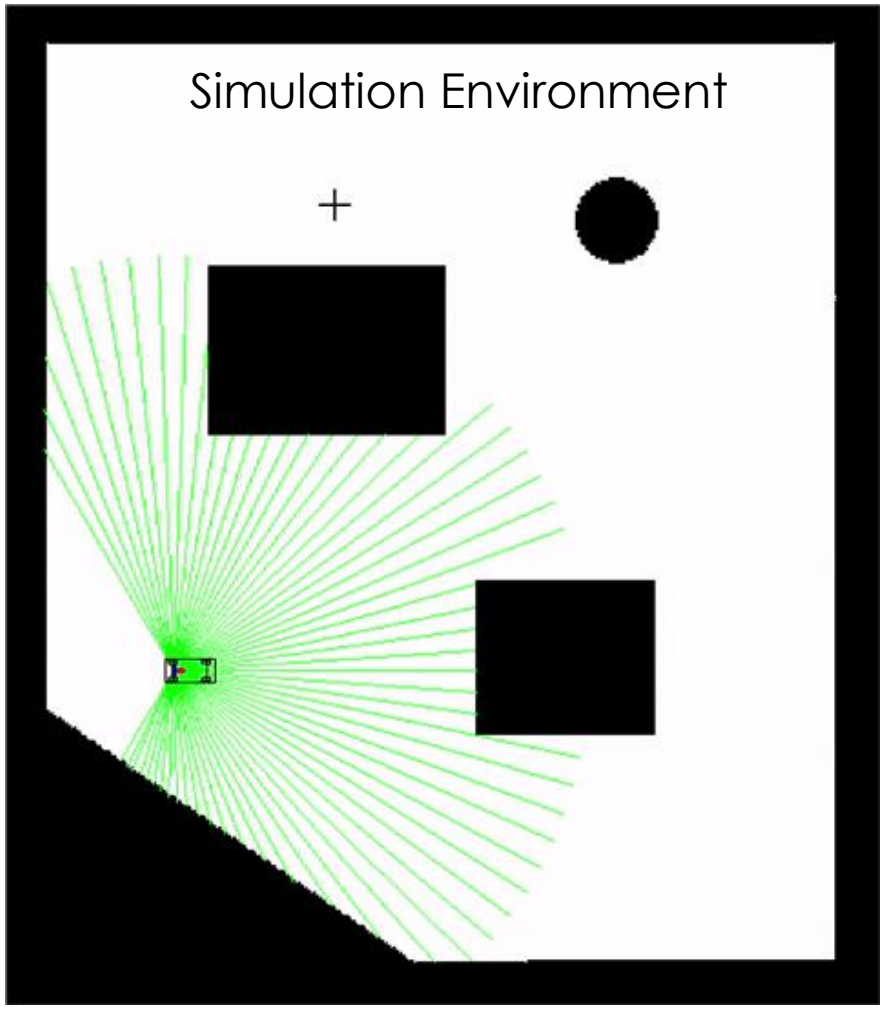
Syllabus

Grading

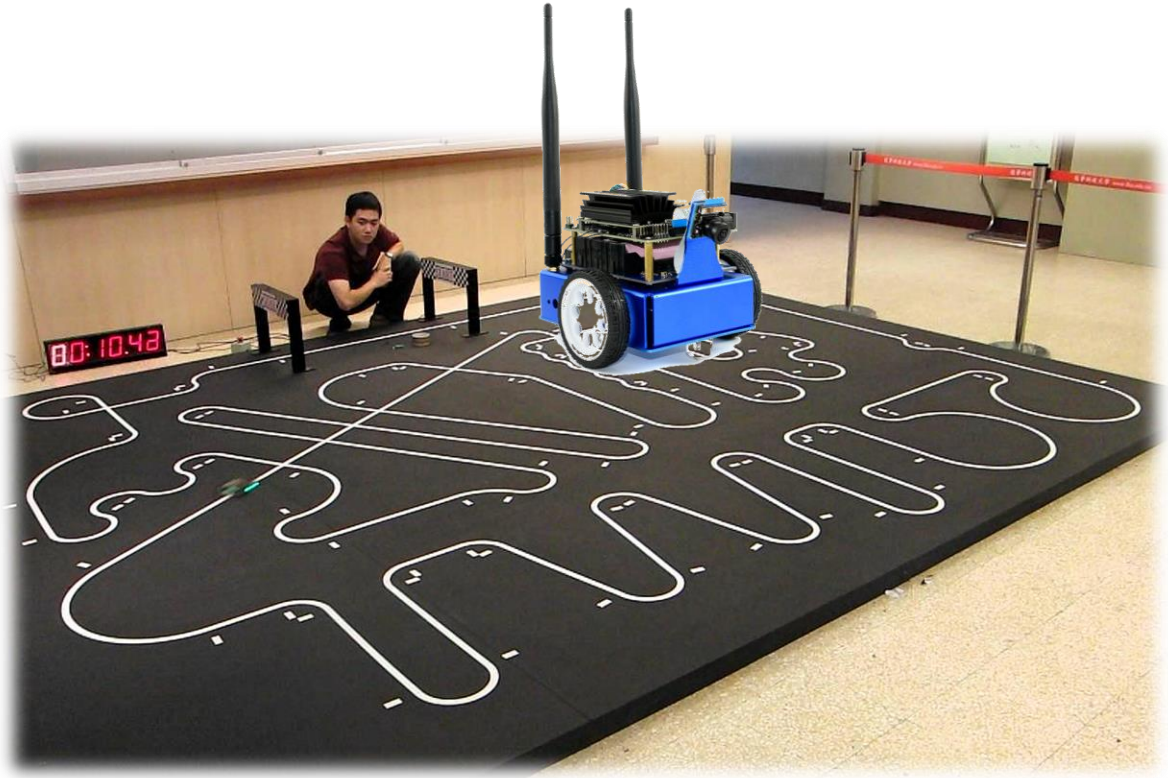
- Homework: 45%
  - HW1~3(15% for each HW)
- Paper Presentation: 20%
  - Presentation (10%)
  - HackMD Report (10%)
- Final Project: 35%
  - Presentation (10%)
  - Demo (15%)
  - HackMD Report (10%)

Date (NTHU)	Date (NCKU)	Course
3/5	3/6	Syllabus & Overview of Mobile Robot
3/12	3/13	Kinetic Model & Vehicle Control Lab1: Feedback Control
3/19	3/20	Path Planning Lab 2: Path Planning + HW1
3/26	3/27	Probabilistic Robotics
4/2	4/3	Spring Vacation
4/9	4/10	Filter-based Localization & Mapping Lab 3: EKF SLAM
4/16	4/17	Camera Model & Multiview Geometry + HW2
4/23	4/24	Modern RGB-based SLAM Methods Lab 4: ORB SLAM & DSO
4/30	5/1	Machine Learning & Deep Learning Basics for CV Lab 5: Street View Segmentation (Pytorch)
5/7	5/8	Advanced CV Algorithms
5/14	5/15	Reinforcement Learning (I) + HW3
5/21	5/22	Reinforcement Learning (II) Lab 6: Mapless Navigation
5/28	5/29	Talk by Trista Chen & Wei-Chao Chen
6/4	6/5	Paper Presentation
6/11	6/12	Talk by 李志清 (Taiwan Drone 100)
6/18	6/19	Demo Day
6/25	6/26	Dragon Boat Festival

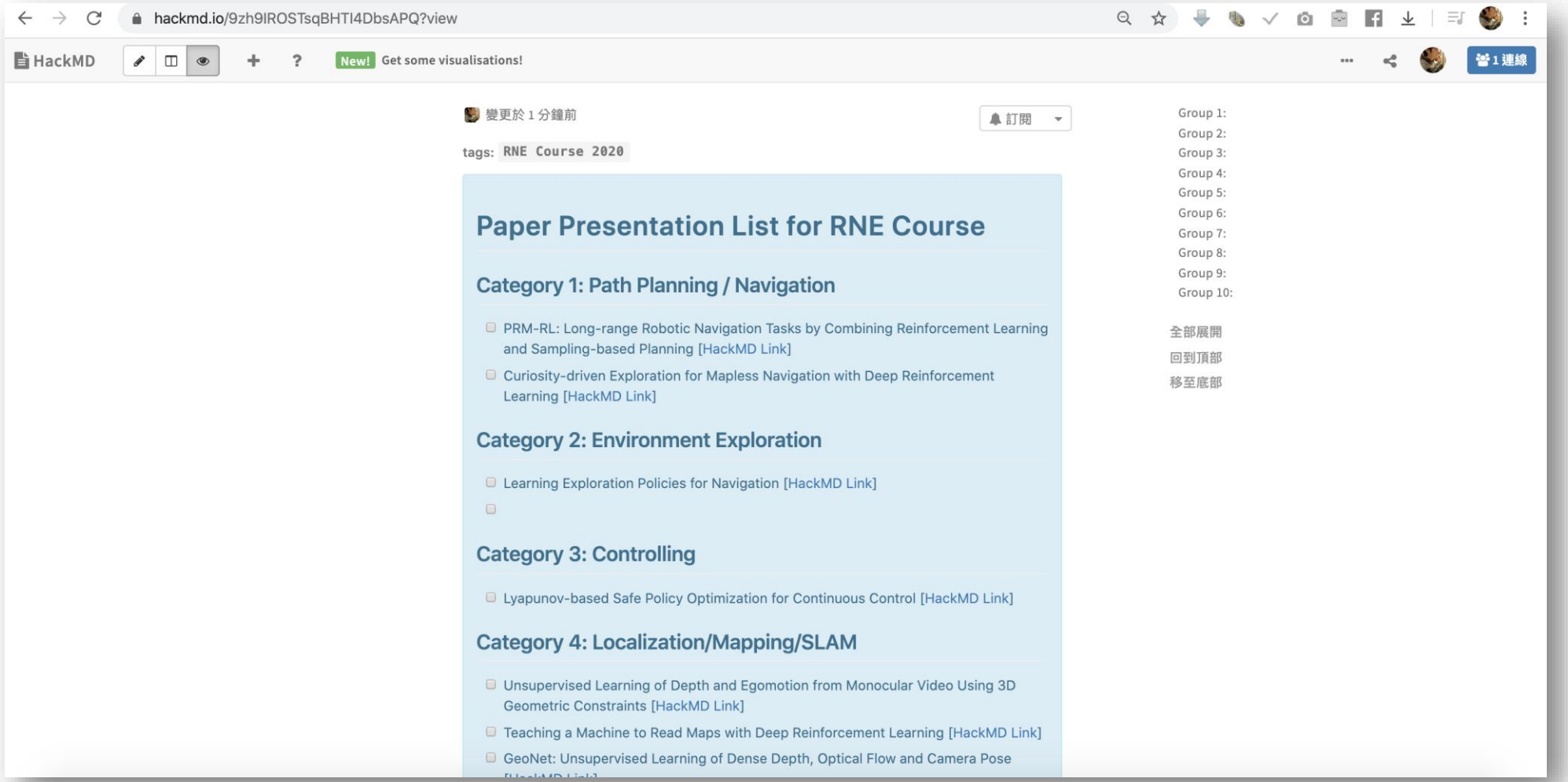
Goal of this course



NVIDIA JetBot in Real World



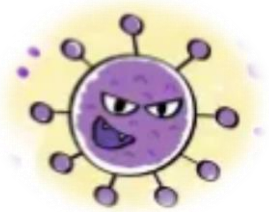
Paper Presentation List https://ppt.cc/fYYC1x



Facebook Group https://www.facebook.com/groups/623146941563602/

Course Q&A

- Take attendance?
- Food?
- Zzz…?



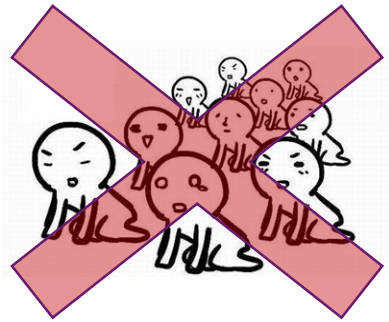
Be Responsible for Yourself

- Cheating or plagiarism will result in zero score

  ➔ Final score=0

- Under 60 or 70 ?

  ➔ See you next year ~



TA

陳文正

李侑霖

王奕翔

許承佑

黃琮耀

古慶宸

彭建瑋 (NCKU)

Any Question

Overview of Mobile Robot

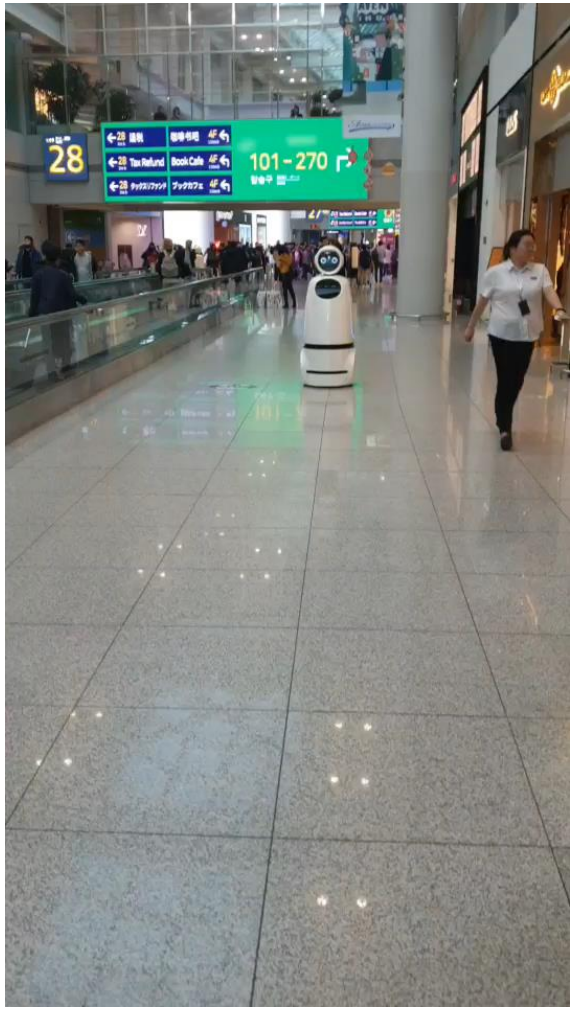
Kiva Robot (Amazon)

https://www.youtube.com/watch?v=HSA5Bq-1fU4

Bossa Nova's Robot (Walmart)

https://www.youtube.com/watch?v=KRJV1SPYpIE

Airport Guide Robot (Incheon)



DataFountain 首页 竞赛 AI指北 数据集 | 我要办赛 人工智能教学实验室 登录 注册

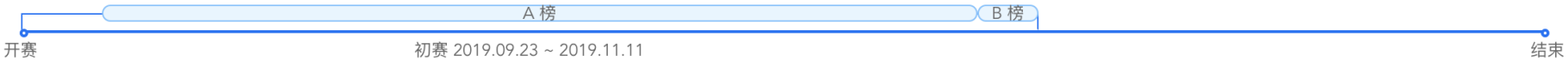
自动驾驶视觉综合感知

主办方： 四维图新

无人驾驶

【2019/11/11 17:09:56】DF1542424200459参加了自动驾...

队伍 / 人数	奖金
629 / 708	¥ 106,500



赛制规则 数据与评测 排行榜 参赛队伍 常见问题 不可报名

- 大赛介绍
- 赛题名称
- 赛题背景
- 赛题任务
- 赛题赛程
- 奖池奖项

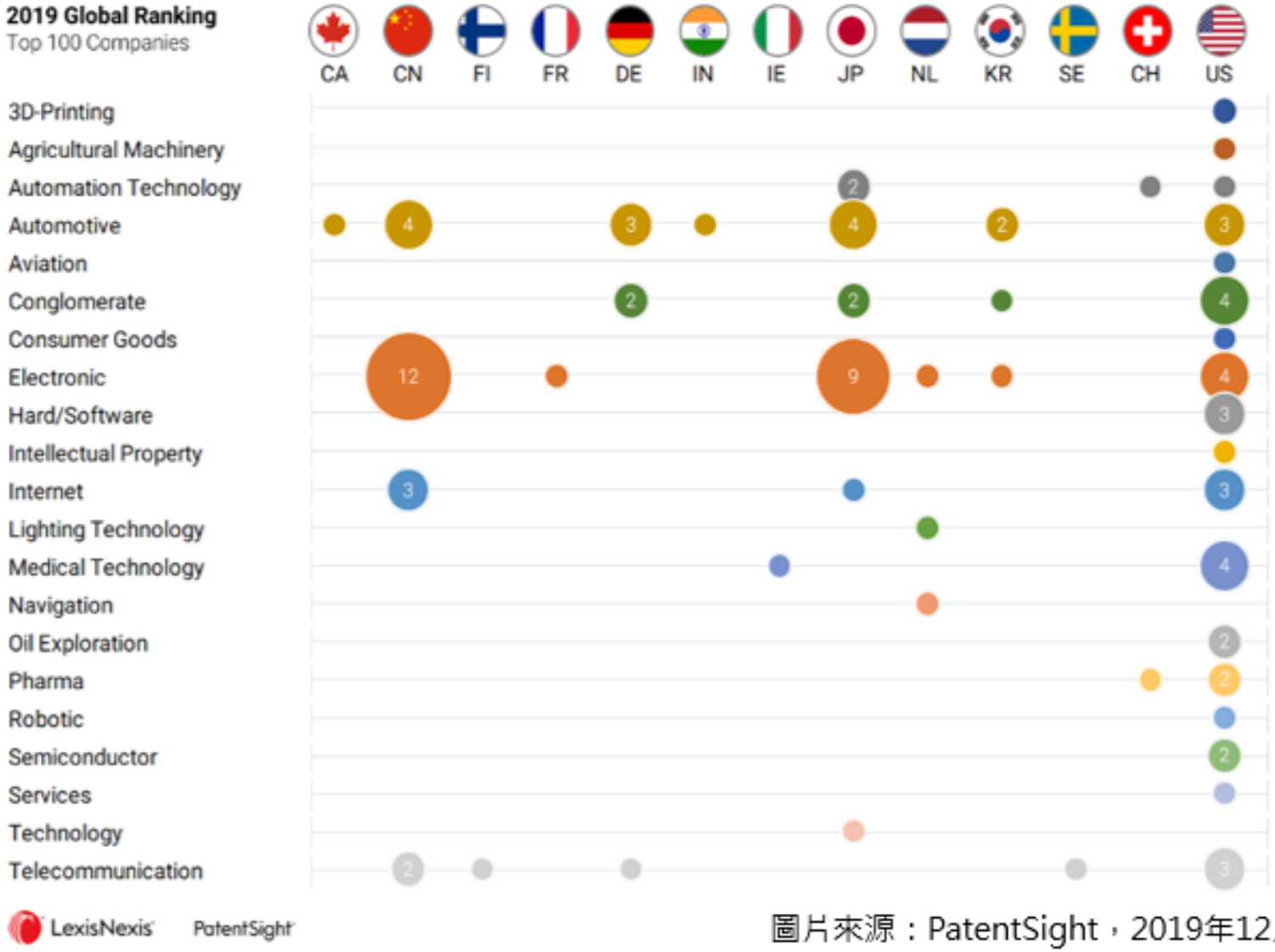
大赛介绍

2019 第五届"四维图新"杯创新大赛，由北京四维图新科技股份有限公司主办，由中国地理信息技术协会指导，中国地理信息产业协会位置服务工作委员会协办。大赛以前沿技术与应用为导向，汇聚创新技术与行业先进经验。

创新大赛连续五年举办，累计吸引全国各大高校在校生以及企业在职人员累计千余人参赛，已成为颇具影响力的行业赛事。大赛秉承"专业·专注·合作·创新"精神，旨在寻找拥有才华和梦想的个人与团队参与赛事，培养地理信息复合型人才。2019年，大赛融入自动驾驶业务和位置大数据元素，立足产业化、规模化、普及化，面向计算机为主、同时覆盖电子信息工程、GIS（地理信息系统）、自动化等专业方向，大赛面向全球开放报名，旨在吸引行业顶尖人才，挖掘领先技术，助力产业升级。

https://www.datafountain.cn/competitions/366

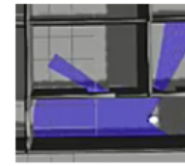
2019年前100最具創新力公司



圖片來源：PatentSight，2019年12月

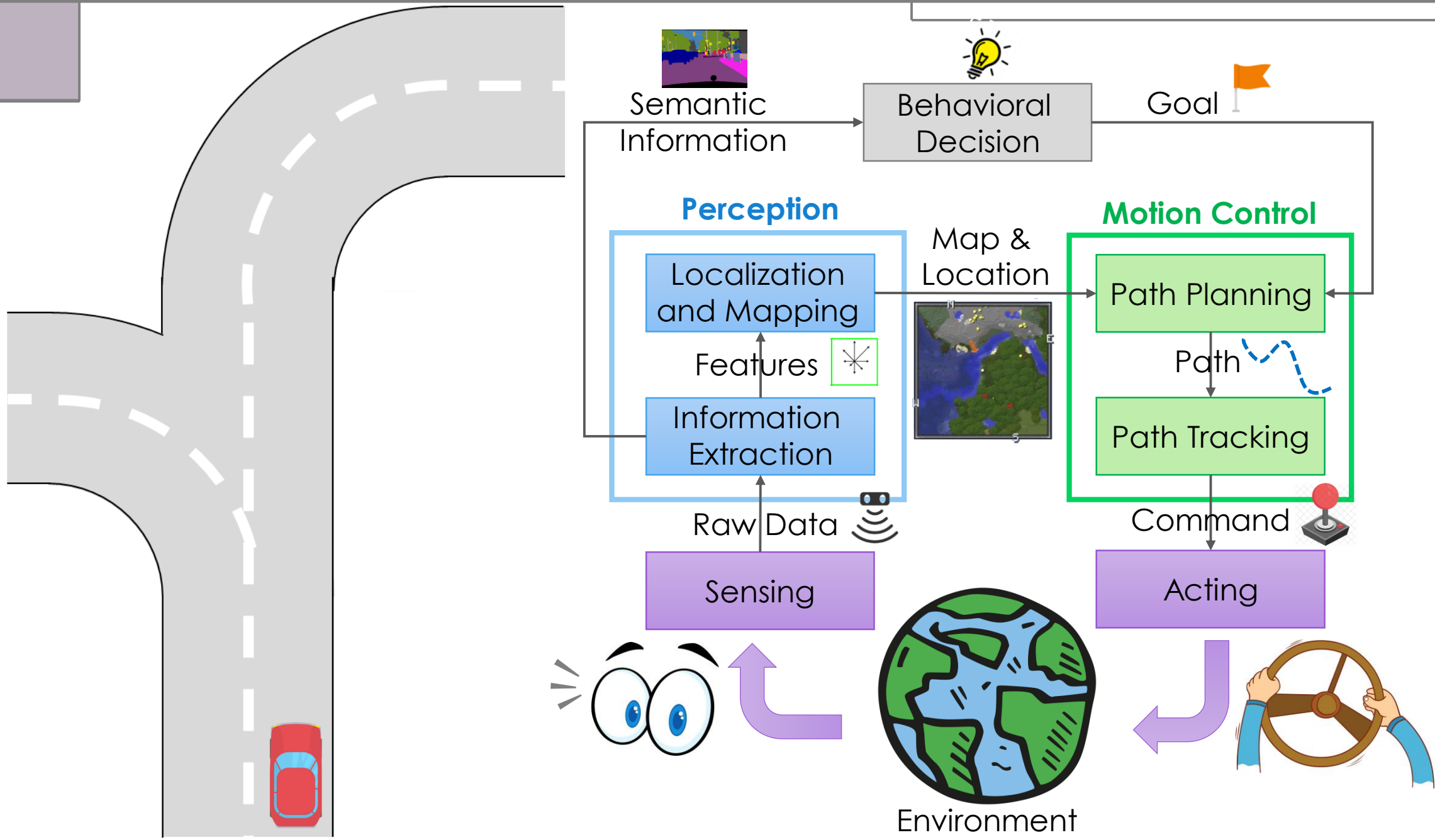
Mobile Robotic in Your Mind

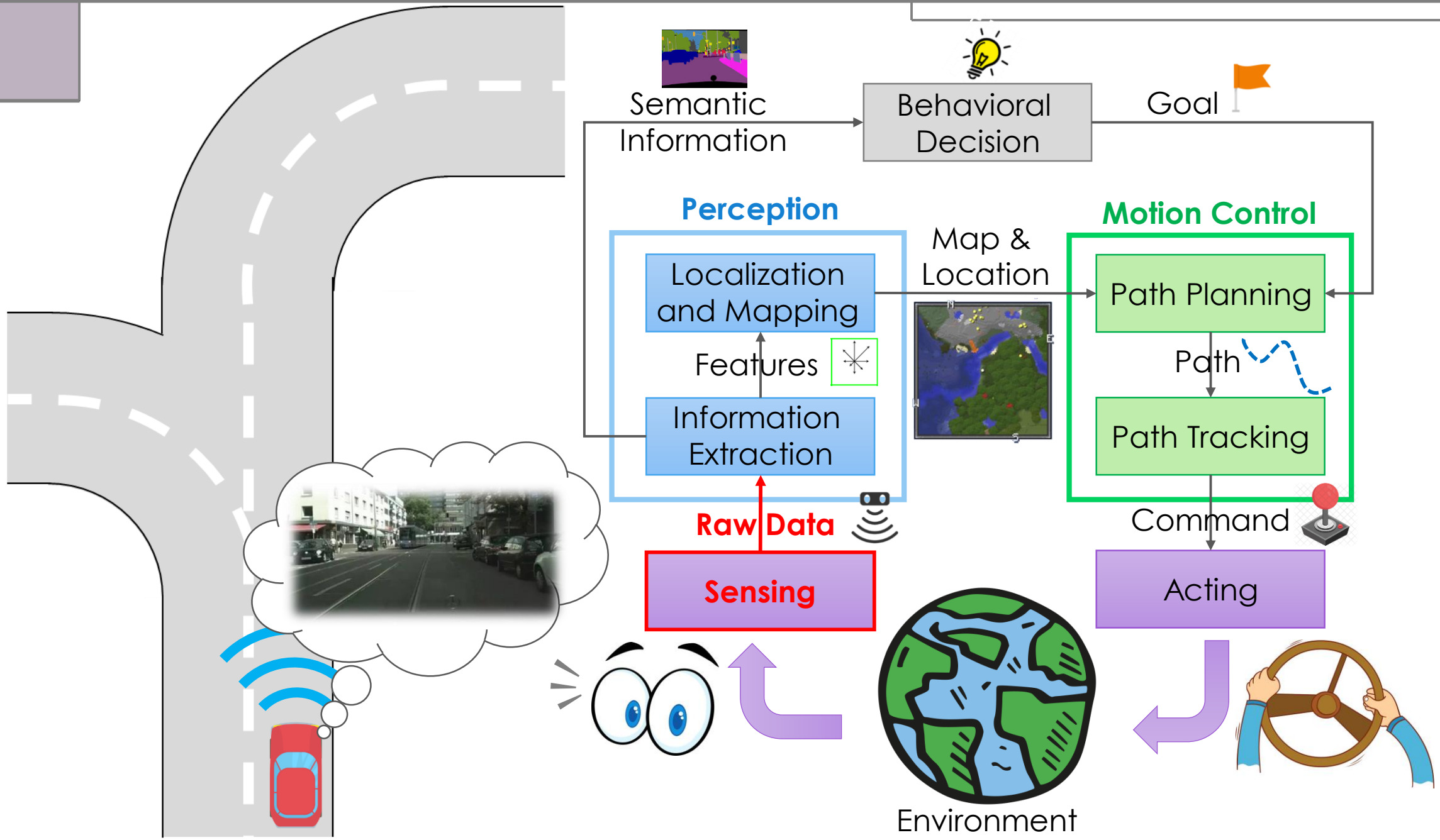
2D laser scan

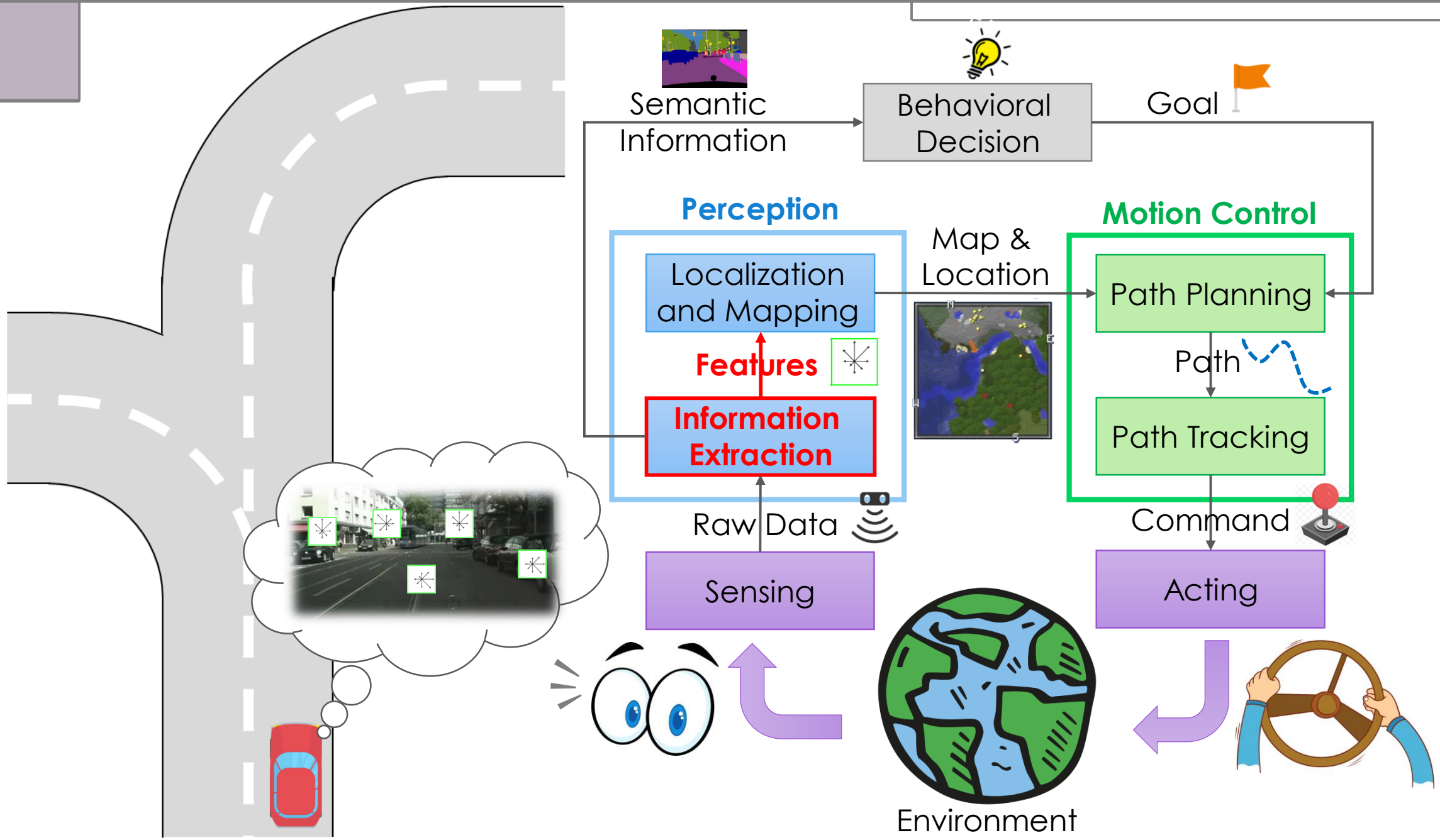


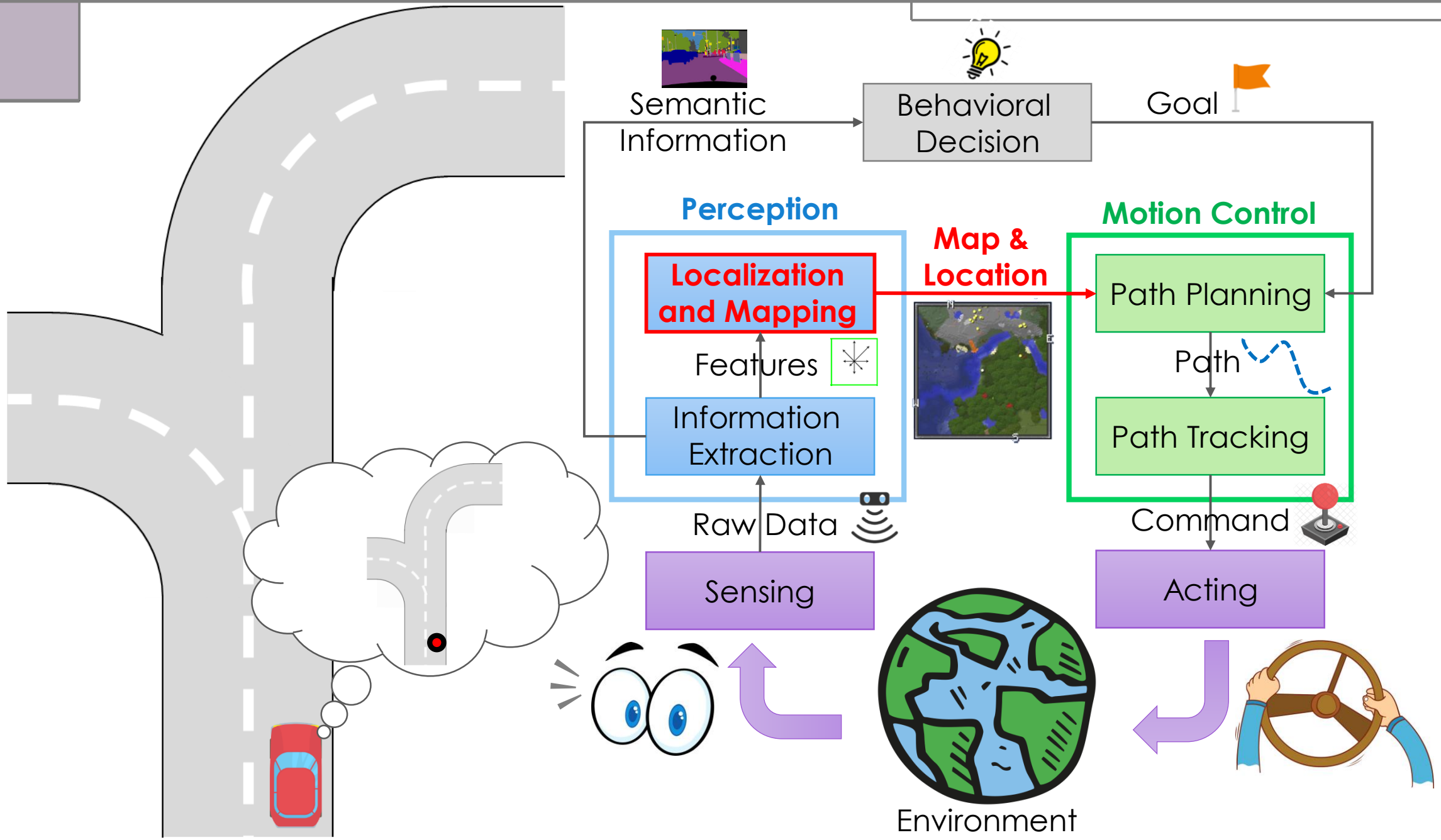
Wheel odometry

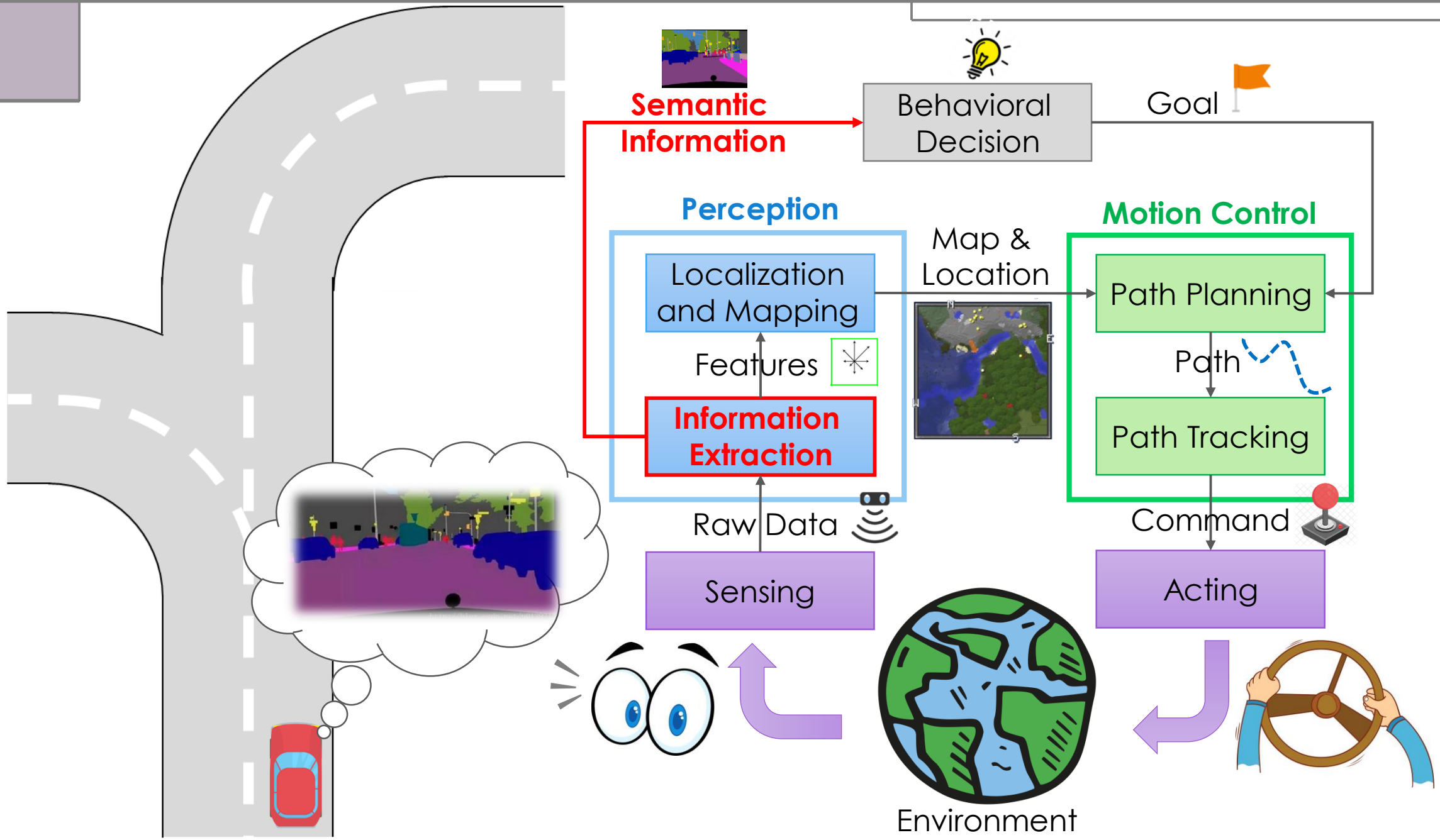
Time's Up

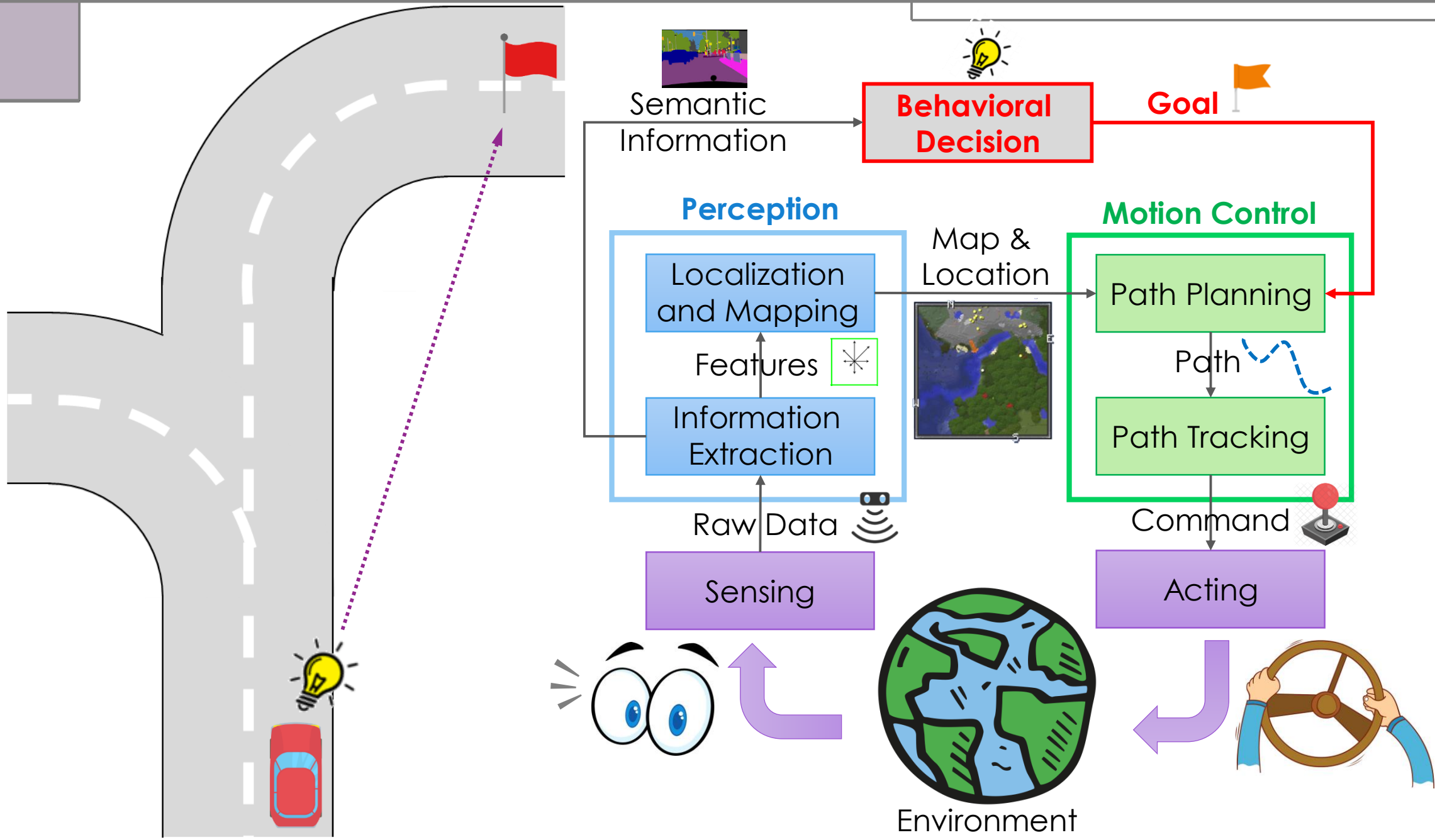

Semantic Information
Behavioral Decision
Goal
Perception
Motion Control
Localization and Mapping
Map & Location
Path Planning
Features
Path
Information Extraction
Path Tracking
Raw Data
Command
Sensing
Acting
Environment

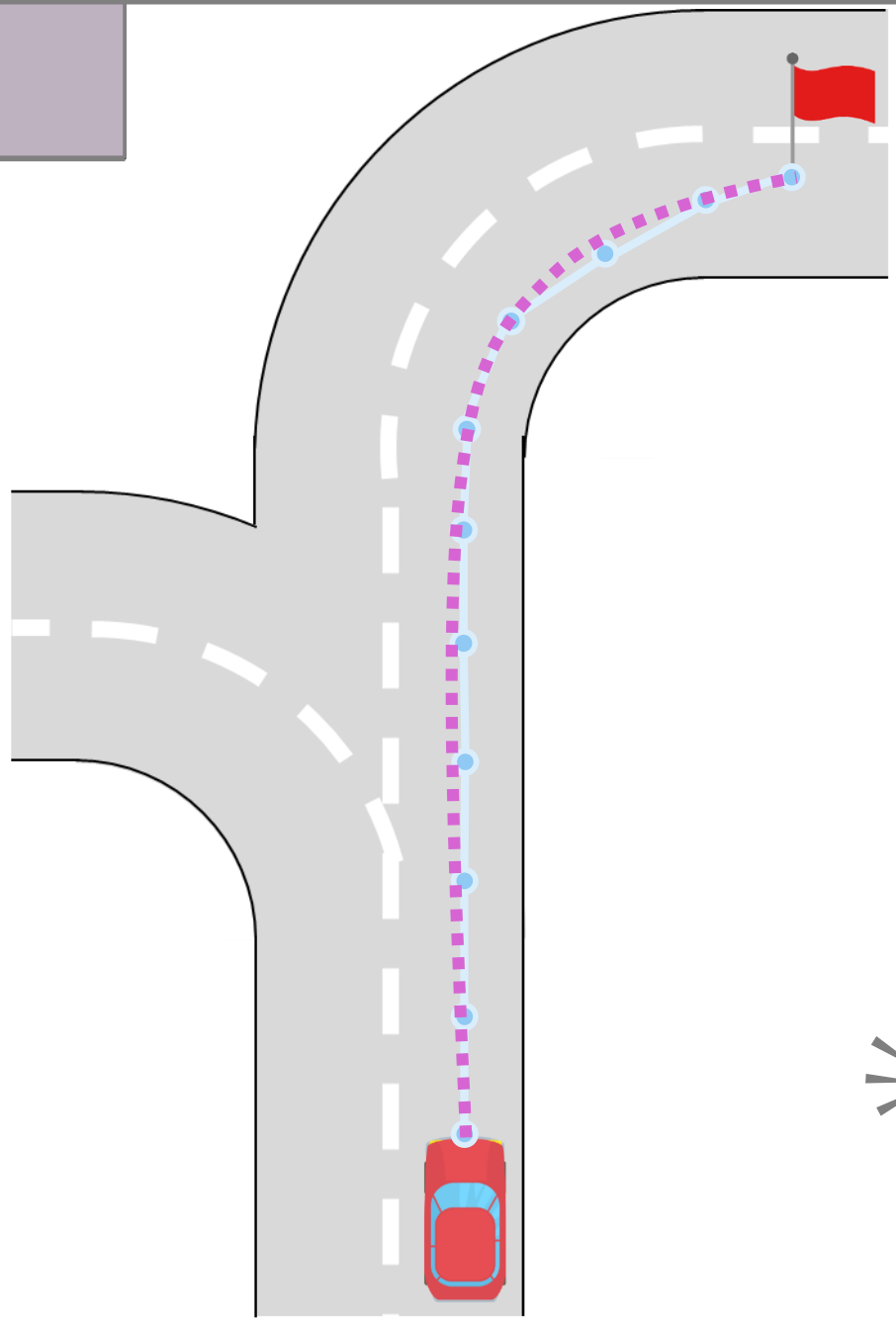

Semantic Information
Behavioral Decision
Goal
Perception
Localization and Mapping
Features
Information Extraction
Raw Data
Sensing
Map & Location
Motion Control
Path Planning
Path
Path Tracking
Command
Acting
Environment


Semantic Information
Behavioral Decision
Goal
Perception
Localization and Mapping
Features
Information Extraction
Raw Data
Sensing
Map & Location
Motion Control
Path Planning
Path
Path Tracking
Command
Acting
Environment


Semantic Information
Behavioral Decision
Goal
Perception
Localization and Mapping
Features
Information Extraction
Raw Data
Sensing
Map & Location
Motion Control
Path Planning
Path
Path Tracking
Command
Acting
Environment


Semantic Information
Behavioral Decision
Goal
Perception
Localization and Mapping
Features
Information Extraction
Raw Data
Sensing
Map & Location
Motion Control
Path Planning
Path
Path Tracking
Command
Acting
Environment


Semantic Information
Behavioral Decision
Goal
Perception
Localization and Mapping
Features
Information Extraction
Raw Data
Sensing
Map & Location
Motion Control
Path Planning
Path
Path Tracking
Command
Acting
Environment



Semantic Information

Behavioral Decision

Goal

Perception

Localization and Mapping

Features

Information Extraction

Raw Data

Sensing

Map & Location

Motion Control

Path Planning

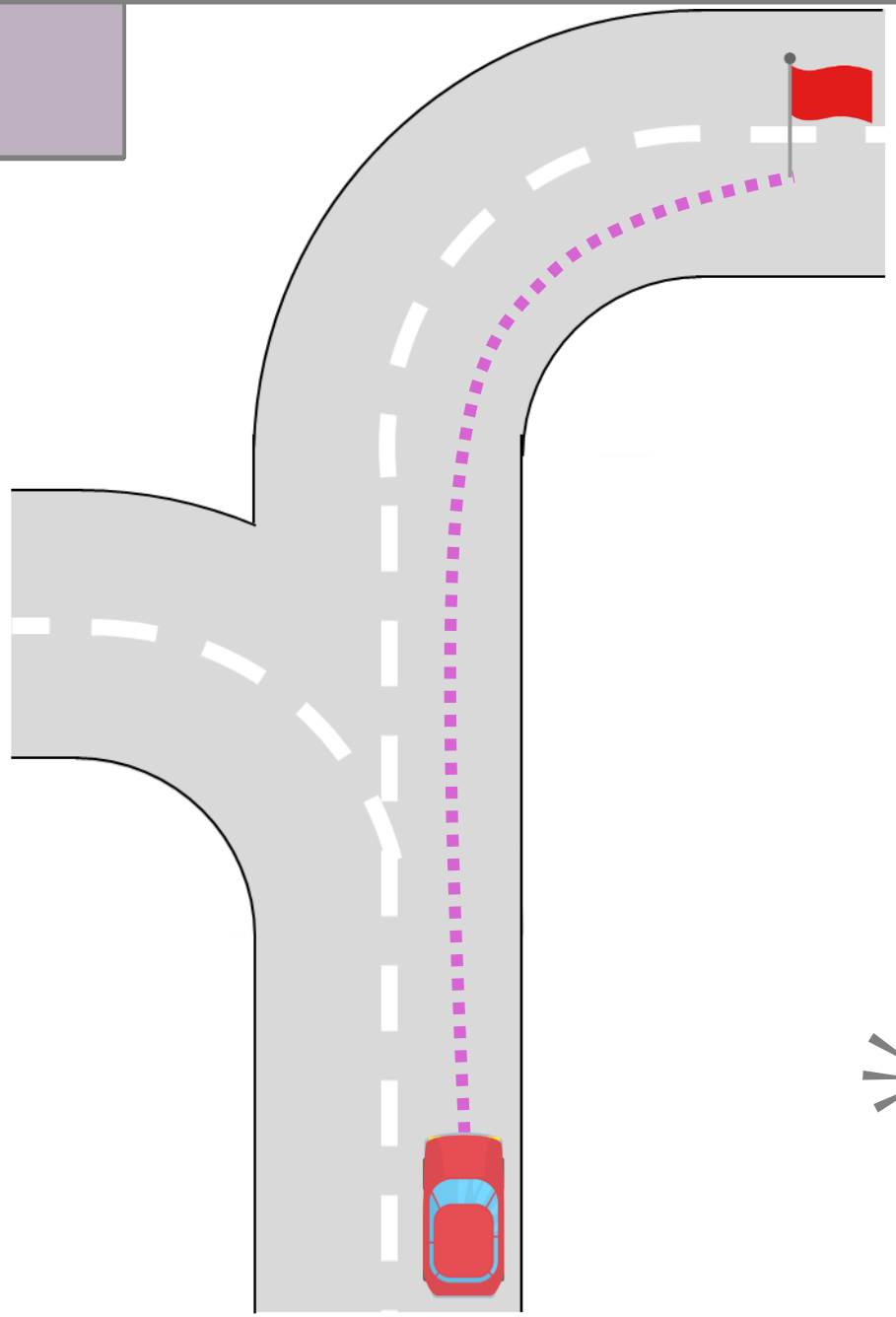
Path

Path Tracking

Command

Acting

Environment



Semantic Information

Behavioral Decision

Goal

Perception

Localization and Mapping

Features

Information Extraction

Raw Data

Sensing

Map & Location

Motion Control

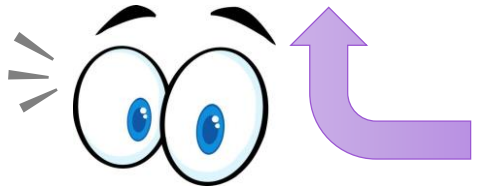
Path Planning

Path

Path Tracking

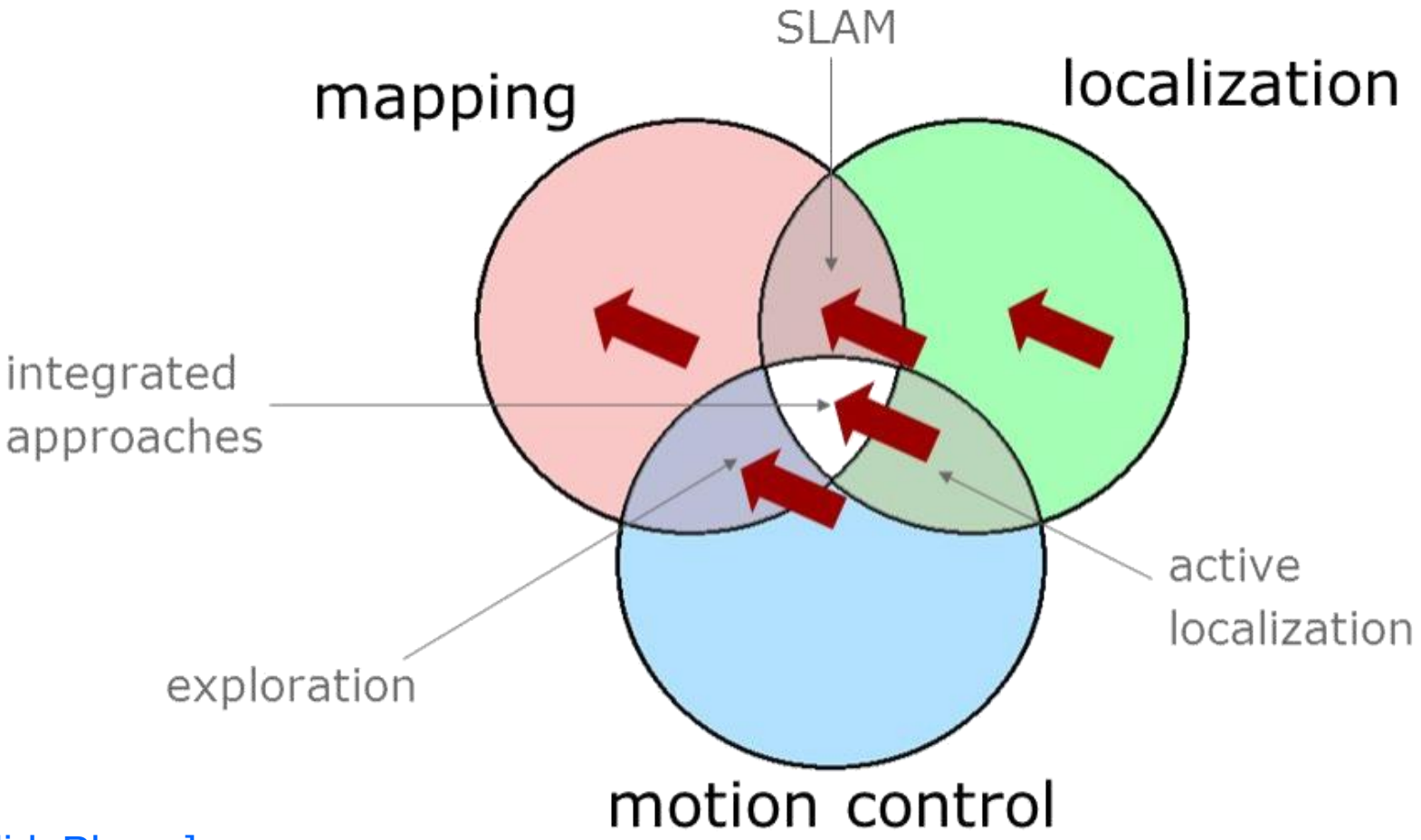
Command

Acting



Environment

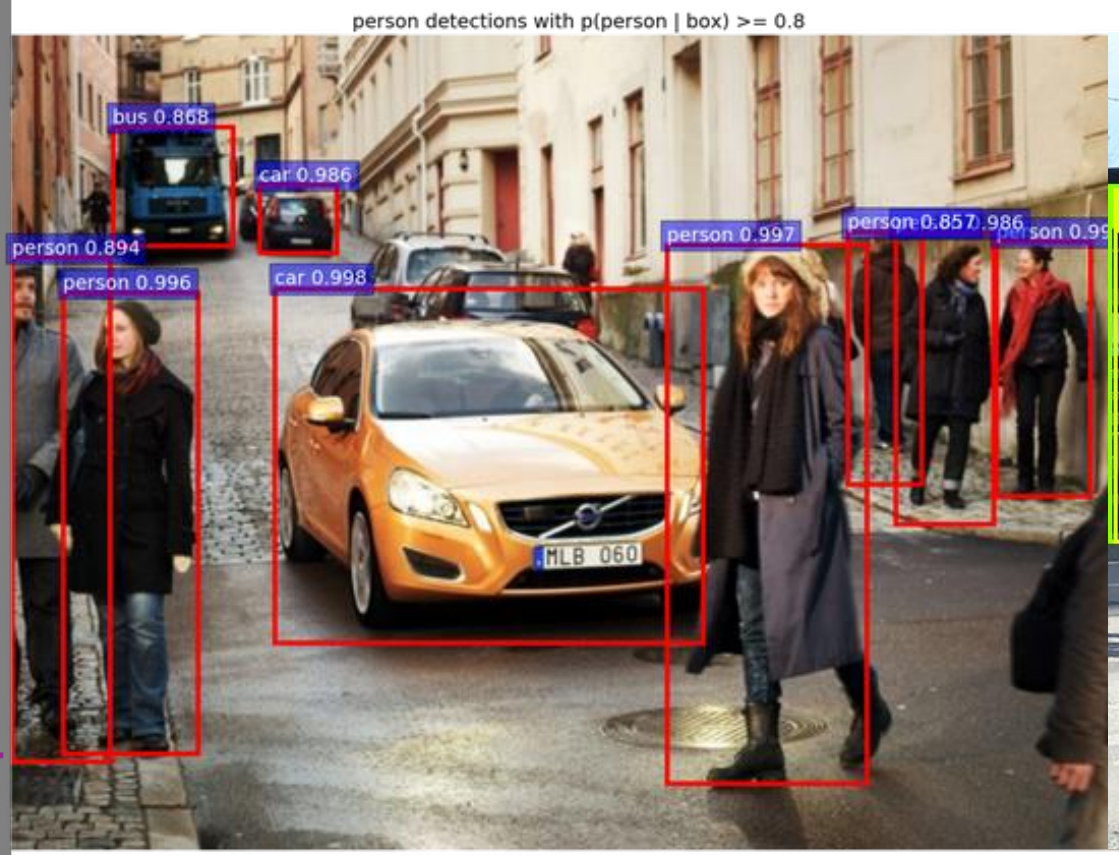
Dimensions of Mobile Robot Navigation

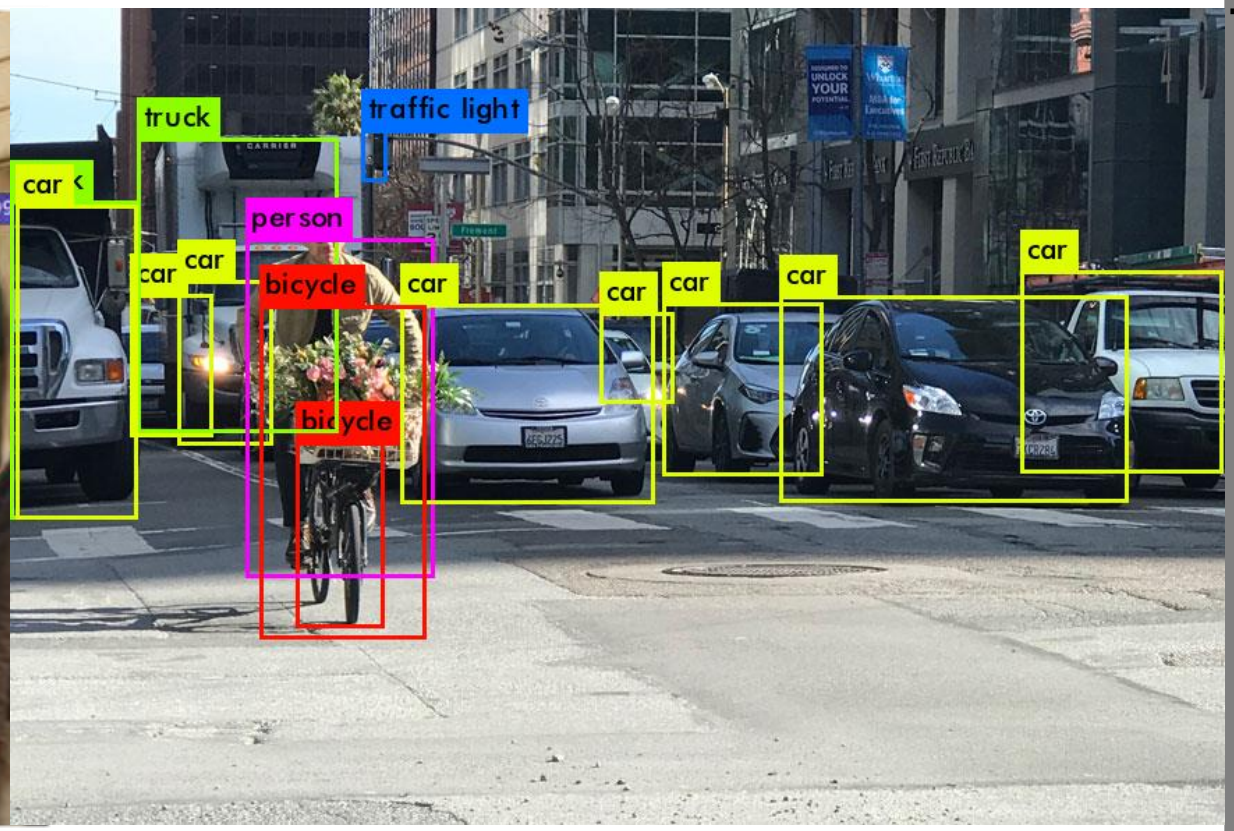


[SlidePlayer]
Probabilistic Techniques for Mobile Robot Navigation

Other Issues

Pedestrian/Car Detection





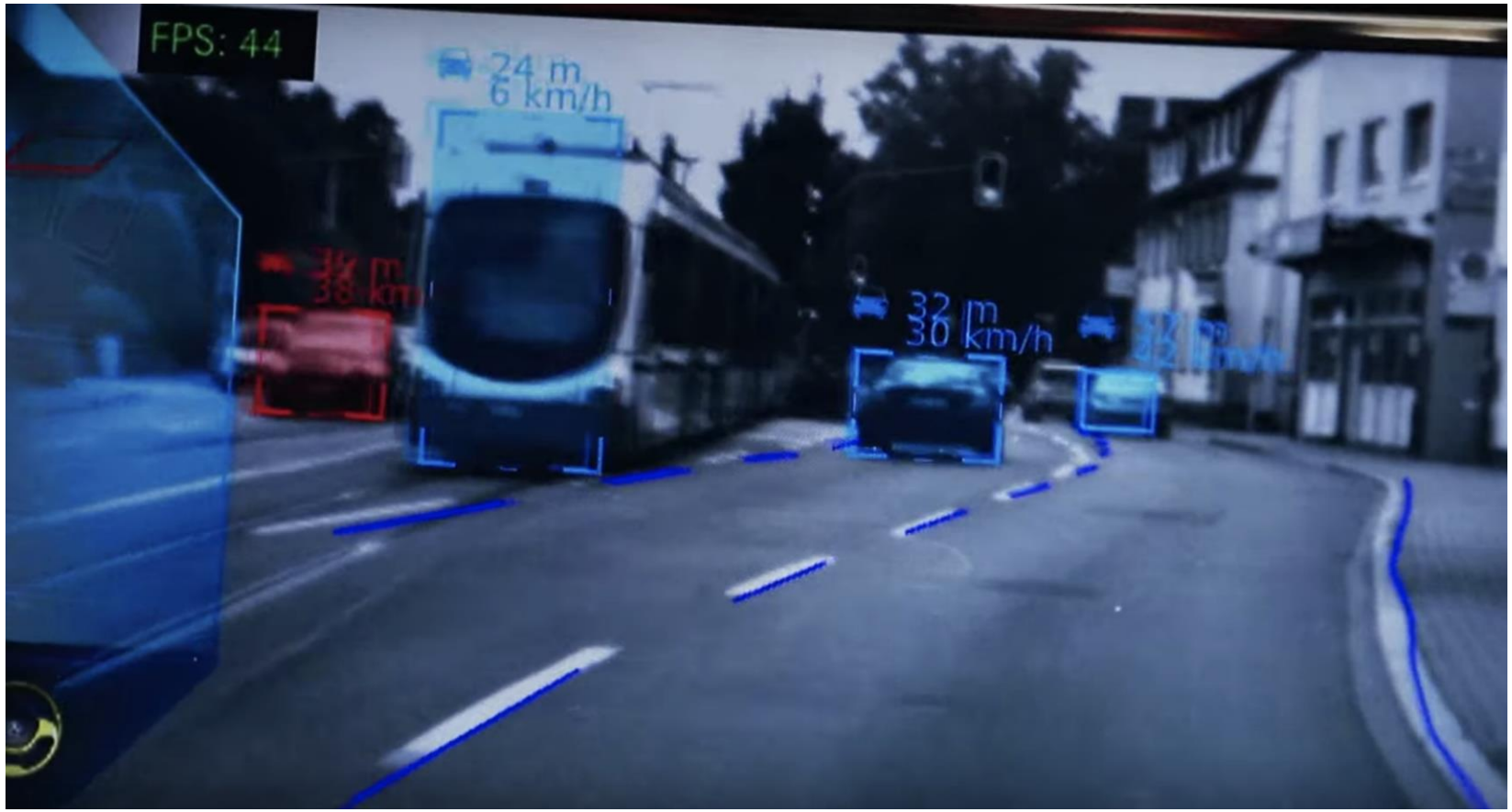
Road Lane Detection

Mercedes-Benz S 500 INTELLIGENT DRIVE | research vehicle

Traffic Light Detection & Identification

Mercedes-Benz S 500 INTELLIGENT DRIVE | research vehicle

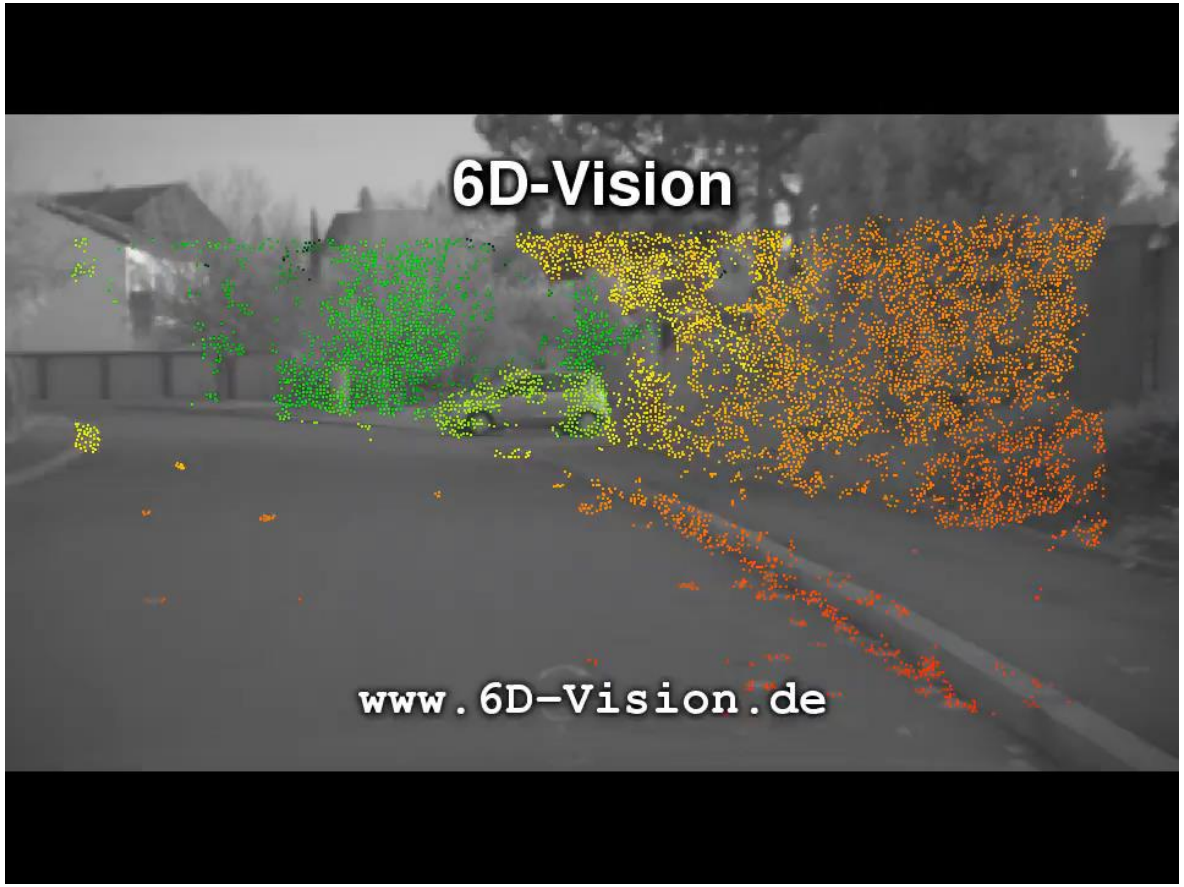
Movement Prediction



Mercedes-Benz S 500 INTELLIGENT DRIVE | research vehicle

Accident Avoiding

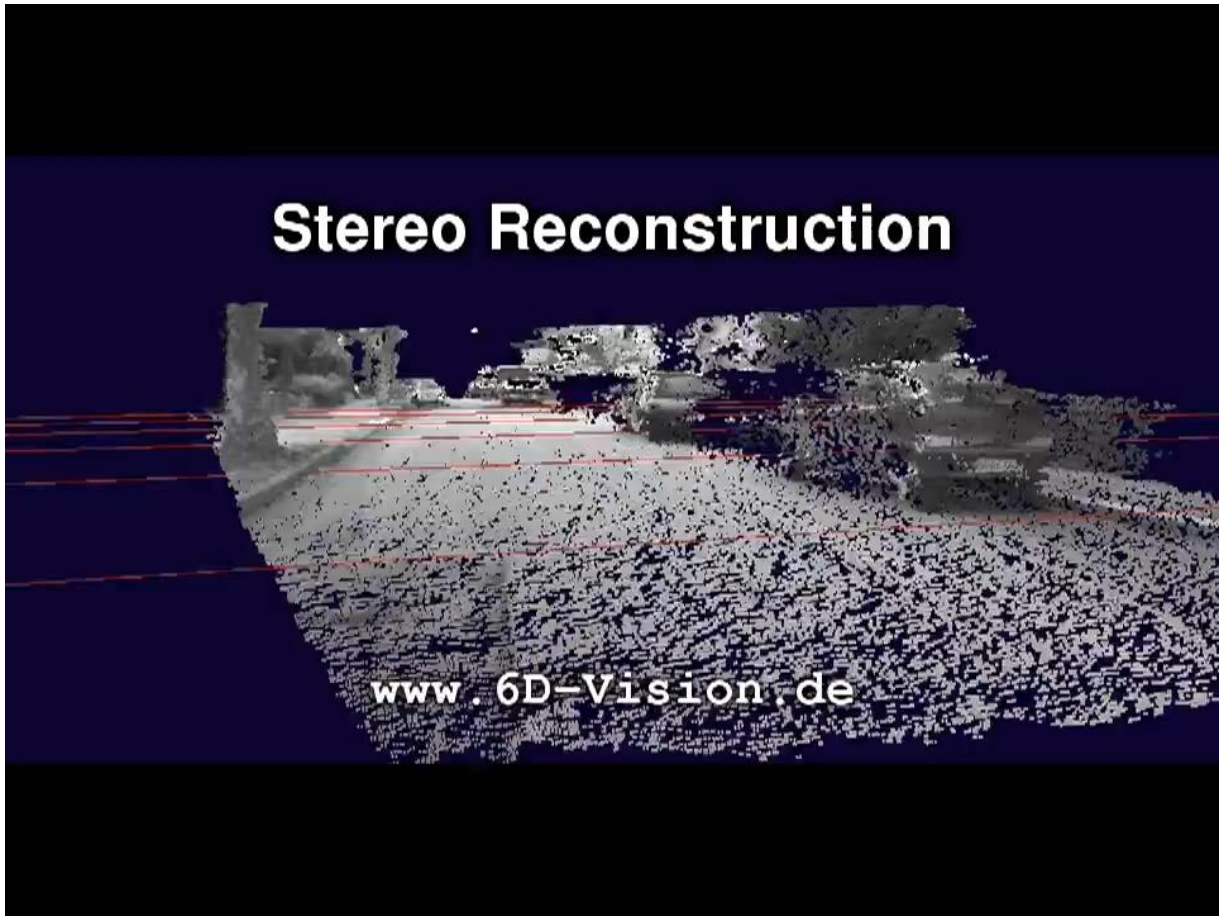
Motion Estimation



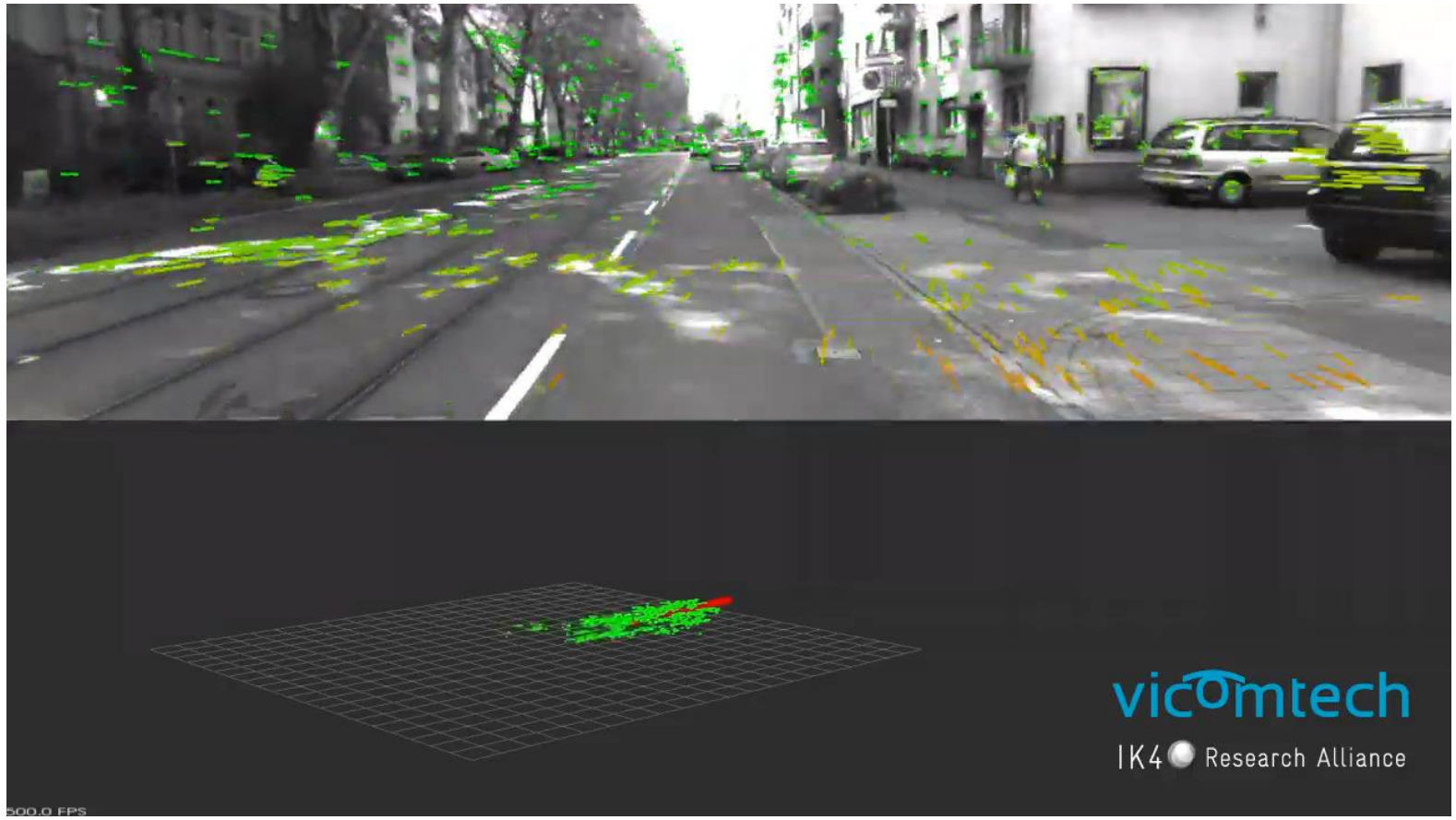
Recognize hazards faster than the human and avoid accidents especially in complex urban traffic situations.

Stereo Reconstruction

- Determines depth to almost every image point in the scene precisely



Ego-Motion Estimation (Visual Odometry)



Real-Time Stereo Visual Odometry and 3D Mapping for Autonomous Navigation
https://www.youtube.com/watch?v=ITQGTbrNssQ

Driver Status Analysis

STONKAM Vehicle Security Products

thanks

https://www.facebook.com/groups/623146941563602/