# Basics of Mobile Robotics presentation

Source:
https://roboticopenplatform.org/wiki/Thymio_II
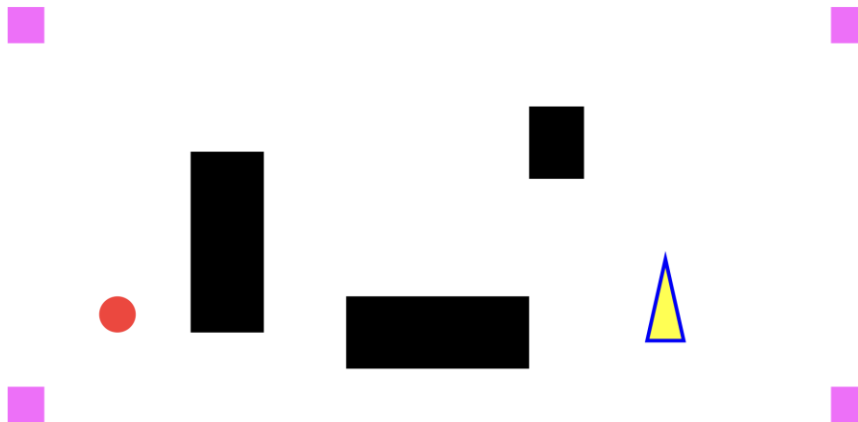
## Professor: Francesco Mondada

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École
polytechnique
fédérale
de Lausanne
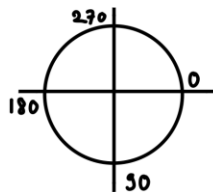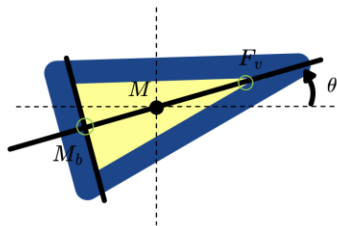
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Camera field of view
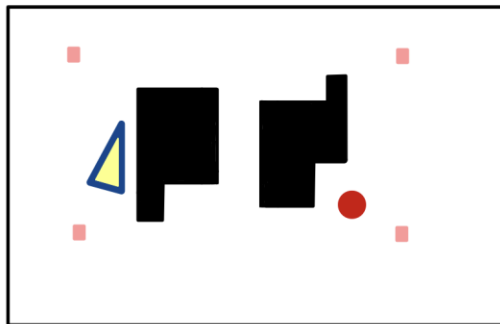
Region of interest
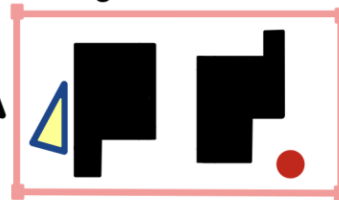
- Anchors
- Targets
- Obstacles
- Robot

Once the region is defined, one computes the robot's orientation and position
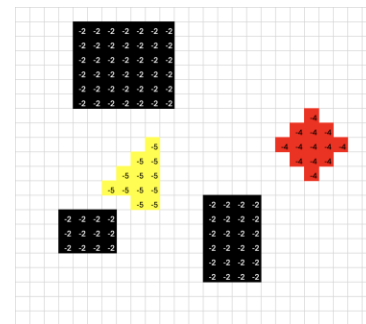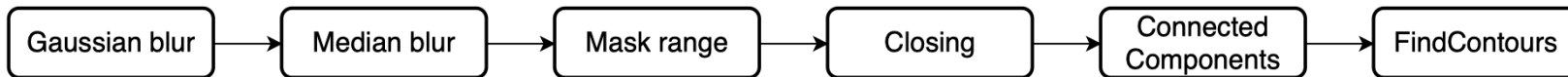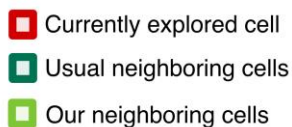
The digital grid is created to compute the global path

Image processing pipeline

| Gaussian blur | → | Median blur | → | Mask range | → | Closing | → | Connected Components | → | FindContours |

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# Global Navigation
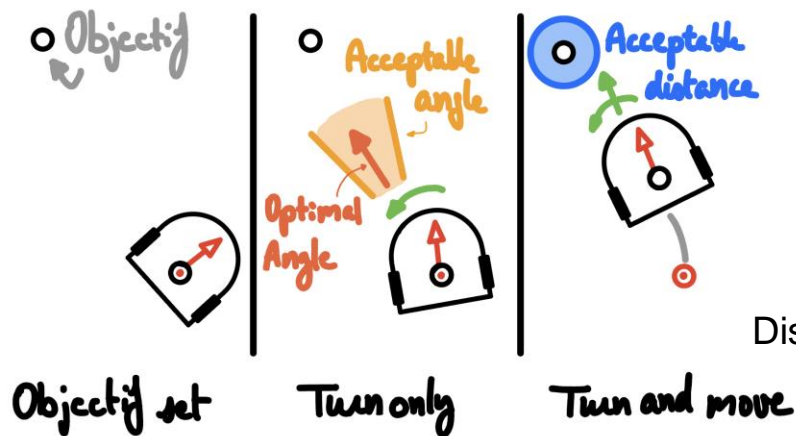
- Use of a **A\* algorithm** with an **approximate cell decomposition** of the map.

- Heuristic function defined as the **euclidian distance** divided by two.

- The neighboring cells explored can be further away than usual.



Currently explored cell
Usual neighboring cells
Our neighboring cells

- The obtained path is then cleaned by removing points where no change of direction occurs.
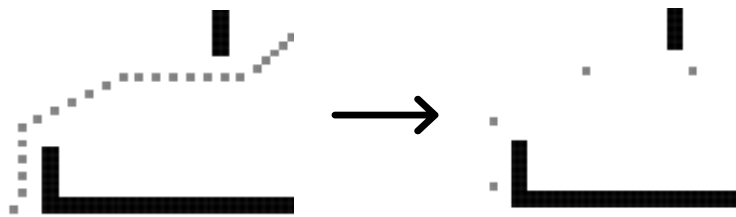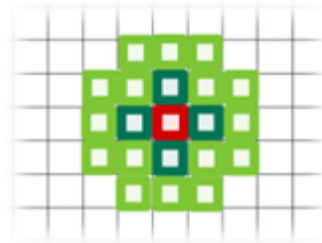
# Motion control

- Motion control based on differential drive

- Angular control based on PID controller



START → New objective set → Calculate angle to turn

Angle > Threshold? → Turn without advancing

Distance > Threshold? → Turn & Advance

Await next objective
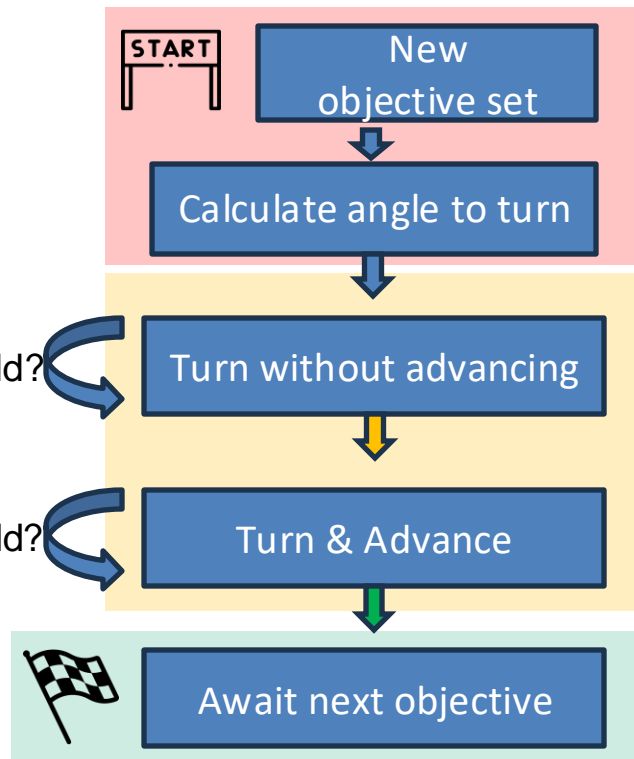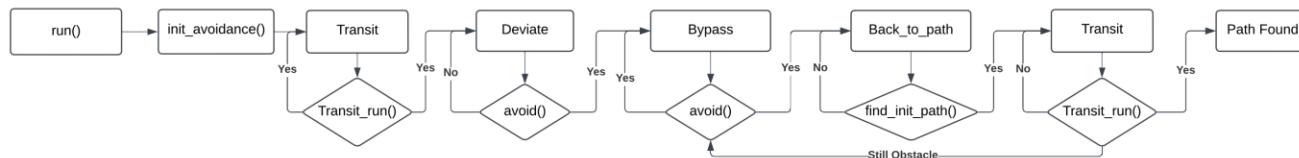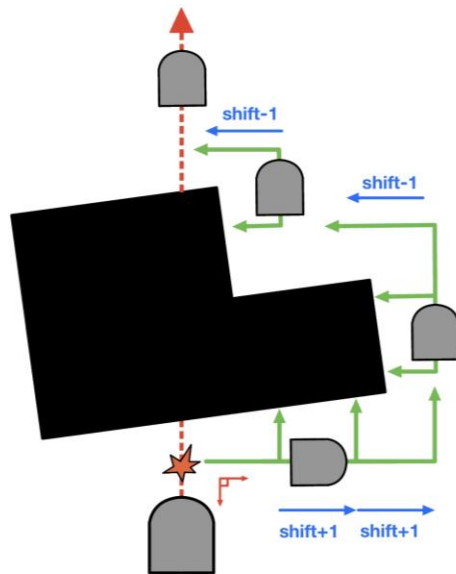
# Local navigation

*Trial-and-error avoidance system*



Execution order :

- ❖ Obstacle detection
  Corresponding state : *Transit*
- ❖ Move away from obstacle
  Corresponding state : *Deviate*
- ❖ Bypass the obstacle
  Corresponding state : *Bypass*
- ❖ Return to initial path
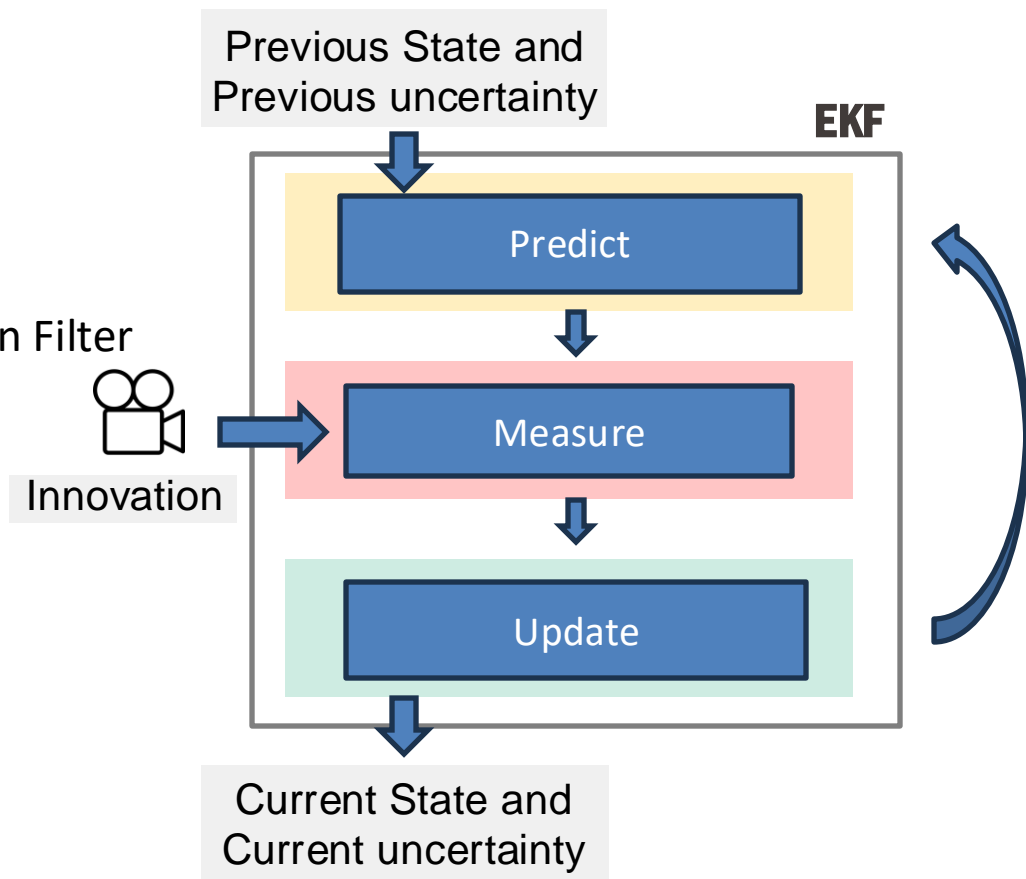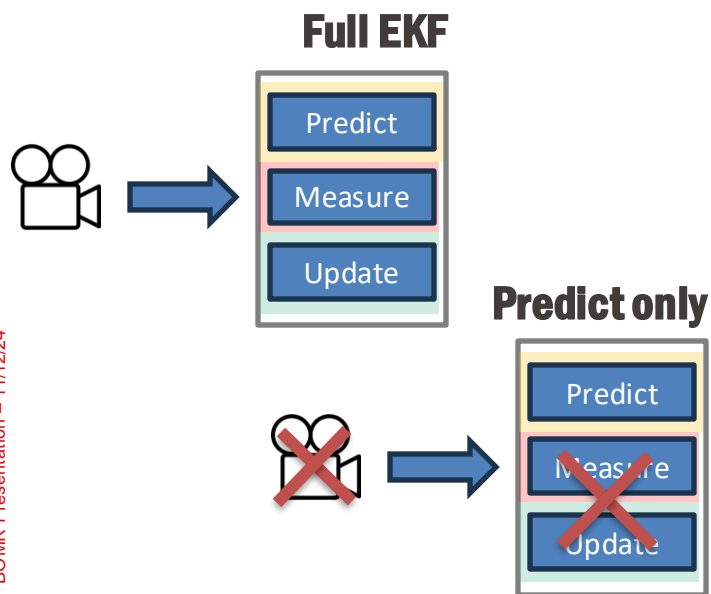  Corresponding state : *back_to_path*

# Kidnapping

Threshold of 18 on both x and y axes of the IMU
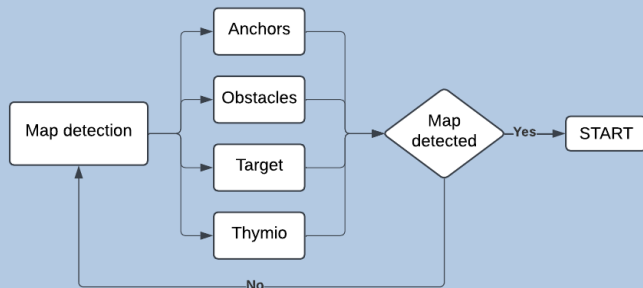
Acceleration
18 x 0,45 ≈ 8.1 N

Return a boolean for the FSM

# Kalman filter

- Improve estimation of state

- Sensor fusion with state estimation
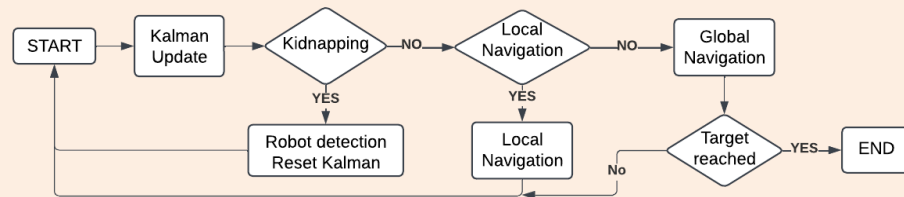
- Non-linear system -> Extended Kalman Filter

**Full EKF**

Predict
Measure
Update

**Predict only**

Predict
Measure
Update

**EKF**

Predict

Measure

Innovation

Update

Current State and Current uncertainty

# Final State Machine

**Let's run it..**

# Demonstration

Questions ?

Thank you !