Zytlebot
~ FPT'21 FPGA Design Competition ~

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Zytlebot

- **Zynq + Turtlebot**
  - Zynq UltraScale+: Heterogeneous MPSoc
  - Turtlebot3 standard Platform robot

ROS

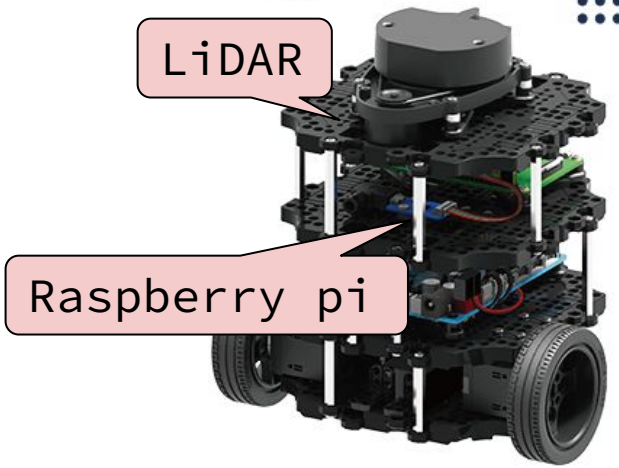
- **FPGA +**

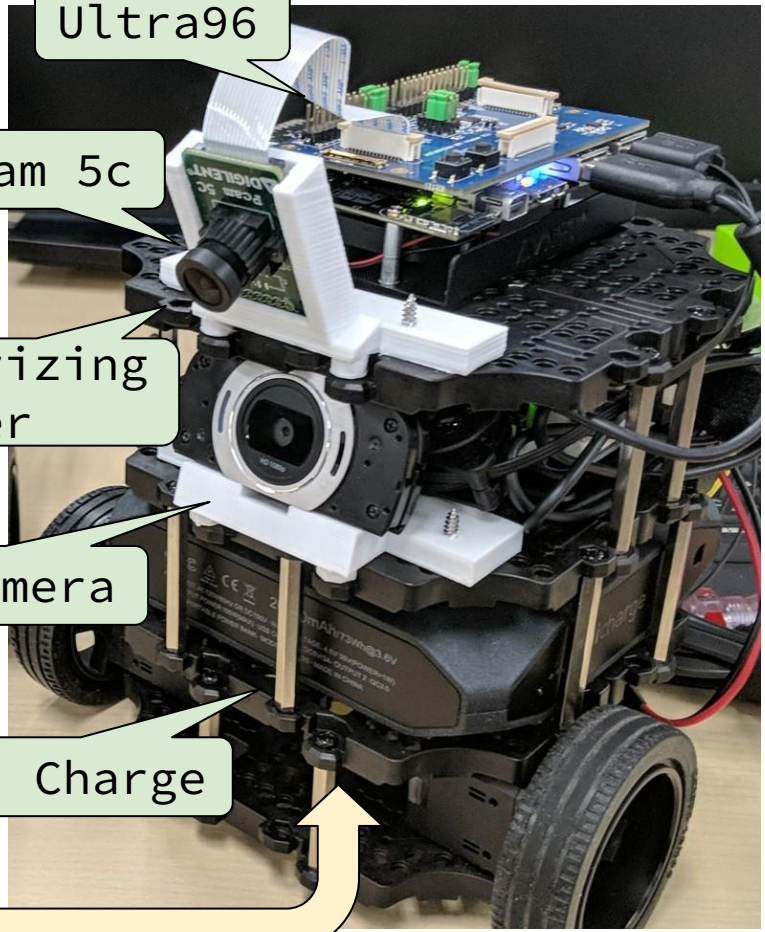
ROS

  - FPGA: Low latency, high throughput and power performance
  - ROS: libraries, tools, and communication middlewares for robot application

Hardware Configuration

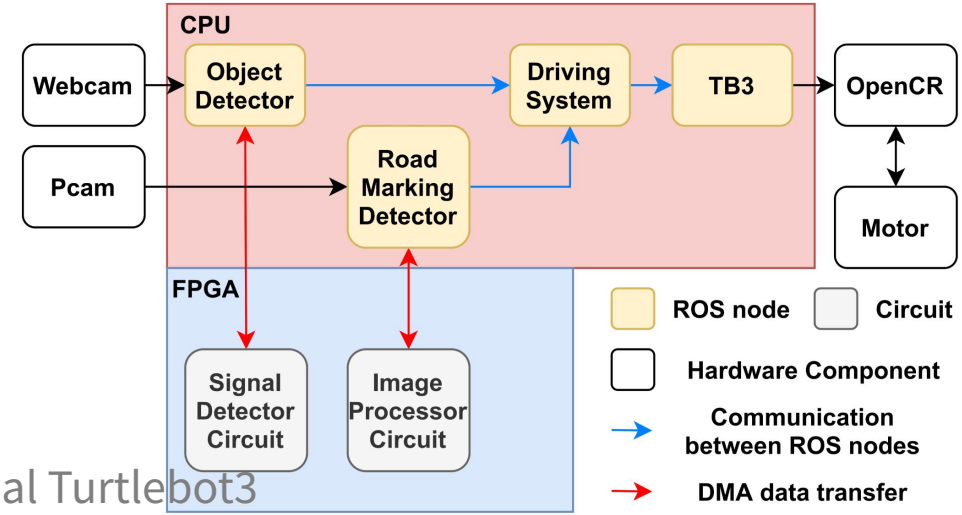
TURTLEBOT3
Burger
ROS 2





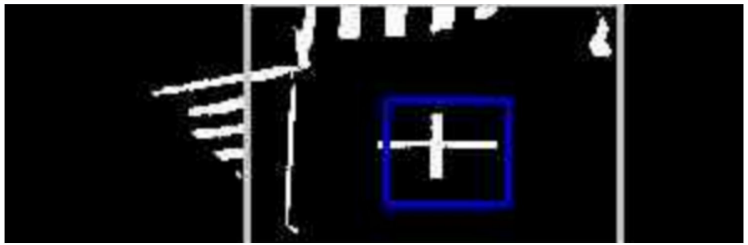
Software Configuration

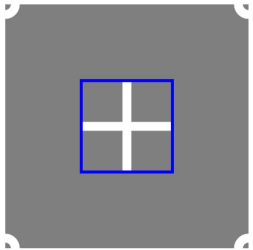
- ROS Nodes wrap FPGA interface
  - No impact on the others
- Line tracing + Object detection
- Vehicle control is adapted from original Turtlebot3
  - High stability
  - Node Driving System determines velocity and angular velocity

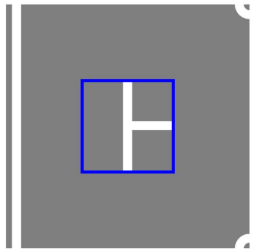


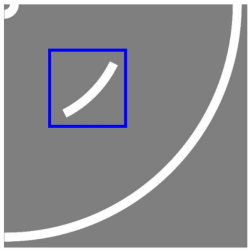
Road Marking Detection

- Polarizing filter
  - Suppress reflected light
- Image Preprocessing
  - Perspective Transformation
  - Adaptive thresholding
  - Rotation
- Template matching



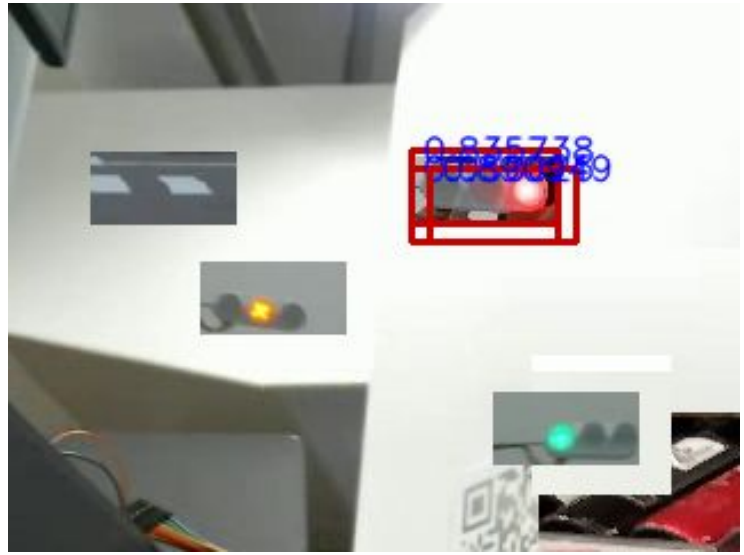


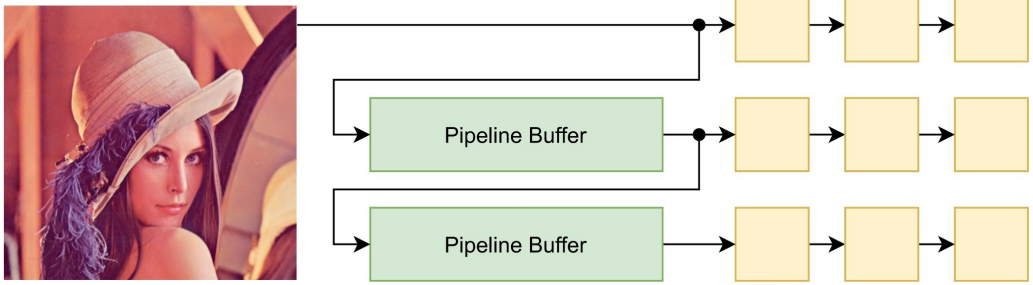




Object Detection: Traffic Light

- Web Camera
  - 240*320pix BGR
- Linear SVM
  - BGR, HSV, HOG(Histogram of Gradients)
  - Pipelined Sliding window
    - 32*64pix window, 8pix stride
    - 200x faster than SW (142fps)





Thank you for your attention.