Scientific and Engineering presentation

Real Time DataBase

FALCONS
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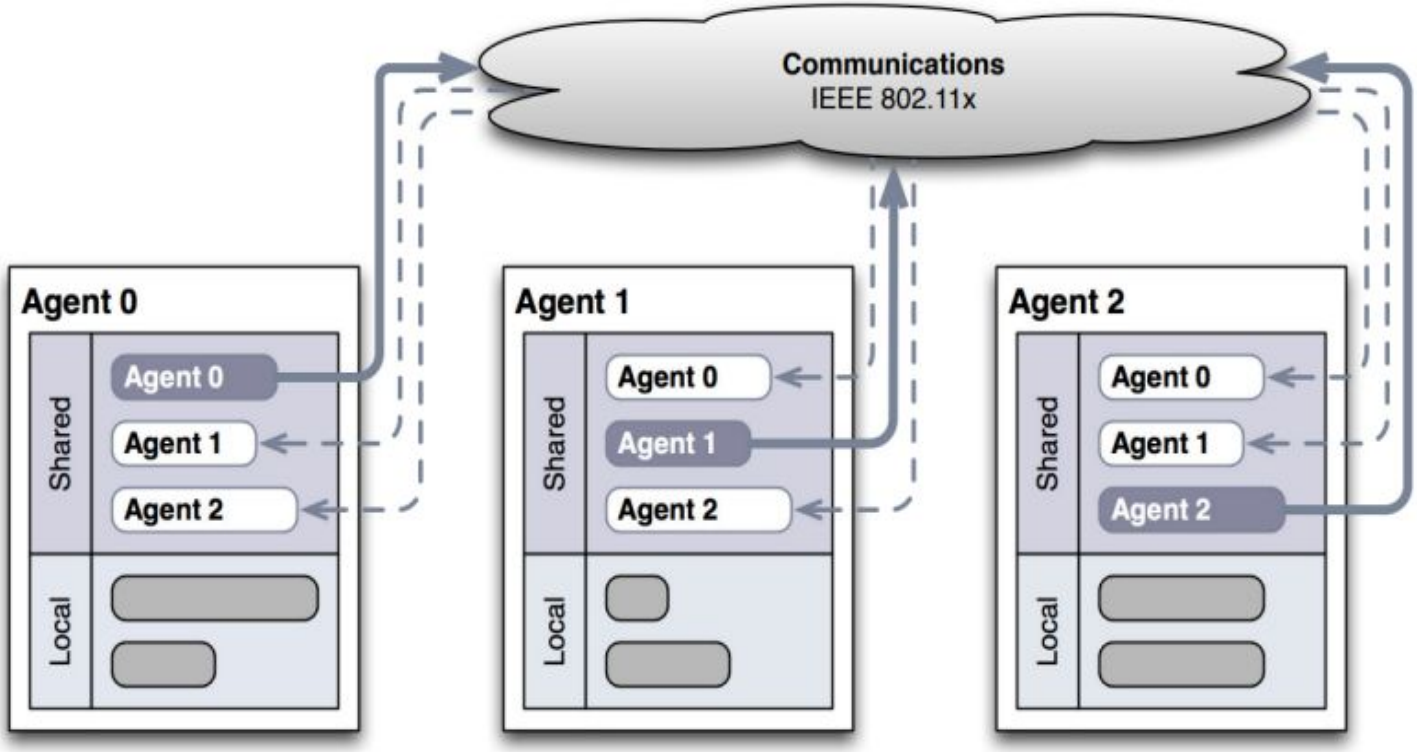
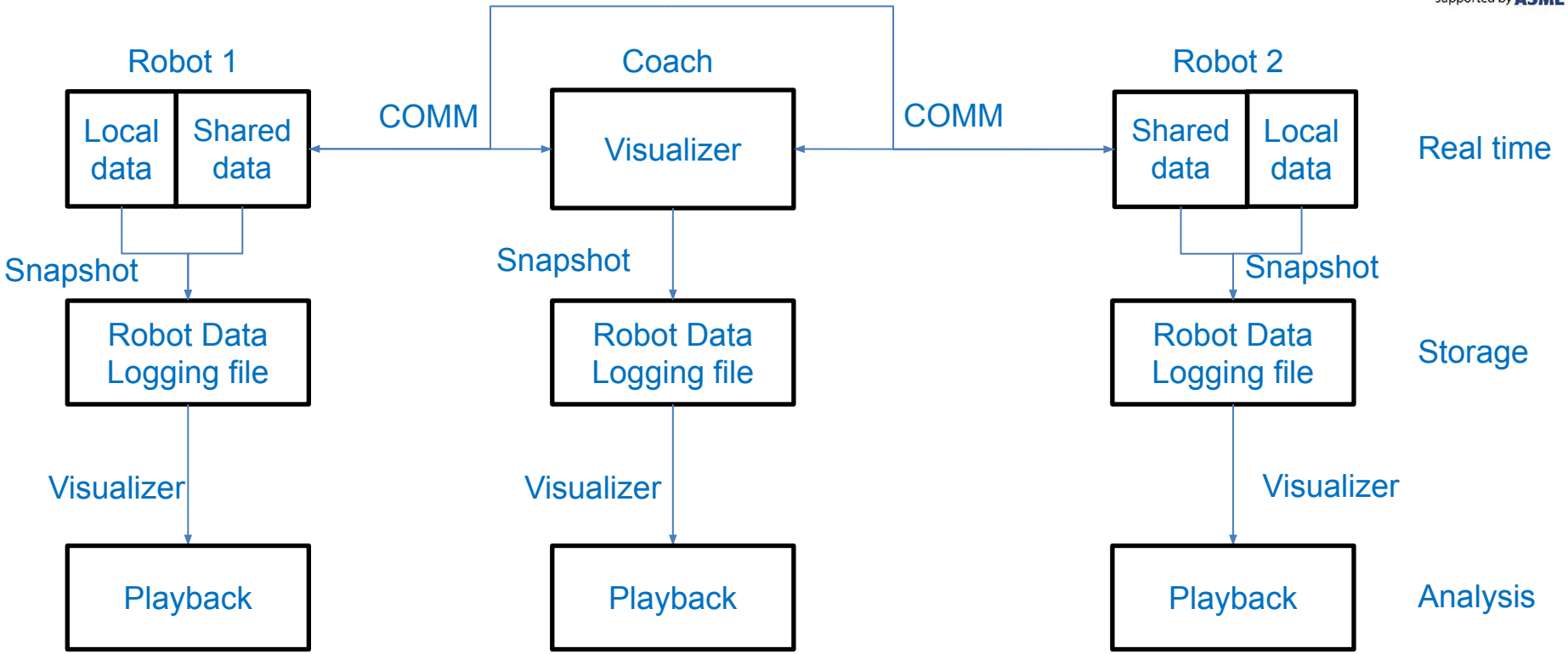
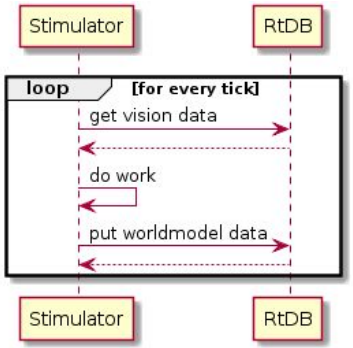
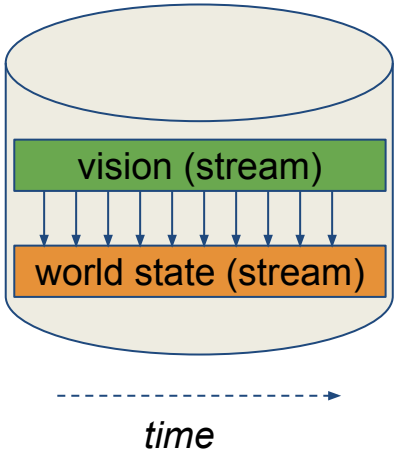


Improvement logging



Improvement Stimulation



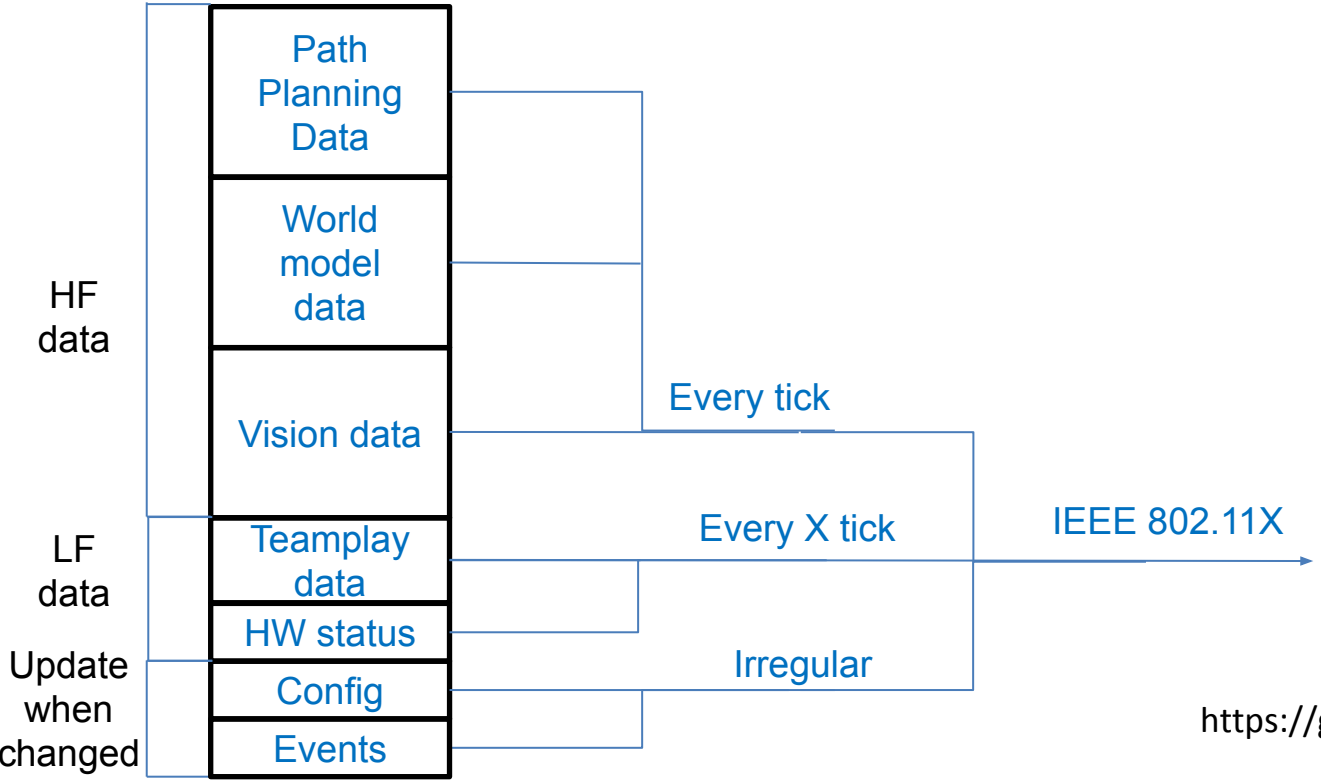


Reference Robot Data Logging file

SW update

New Robot Data Logging file

Improvement Comm2



Reduction by a factor of two achieved, more possible

https://github.com/Falcons-Robocup

Vision

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Synchronizing Asynchronous Cameras

Vision Introduction

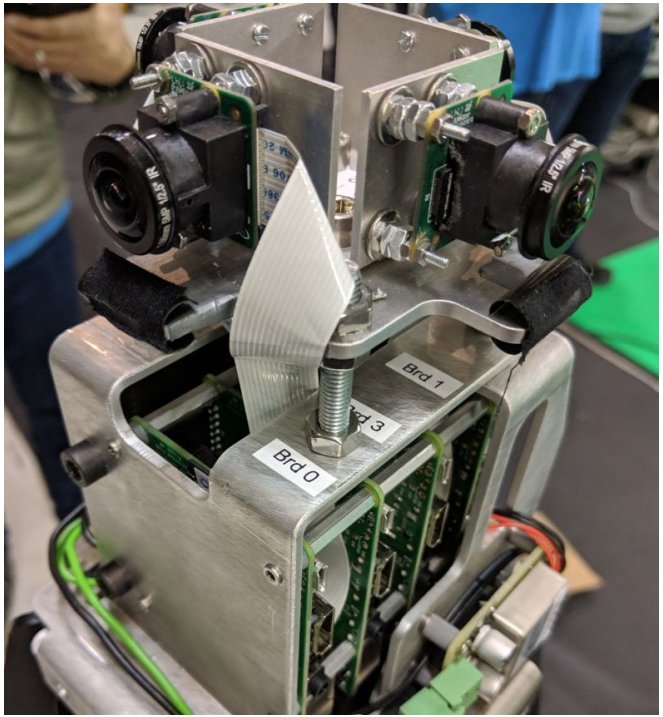
4 Raspberry pi cameras (+ 4 Raspberry pi boards)

- low budget (mobile phone market)
- rolling shutter
- **no** synchronization input
- camera access through i2c
- camera driver (GPU) **closed source**

Used for

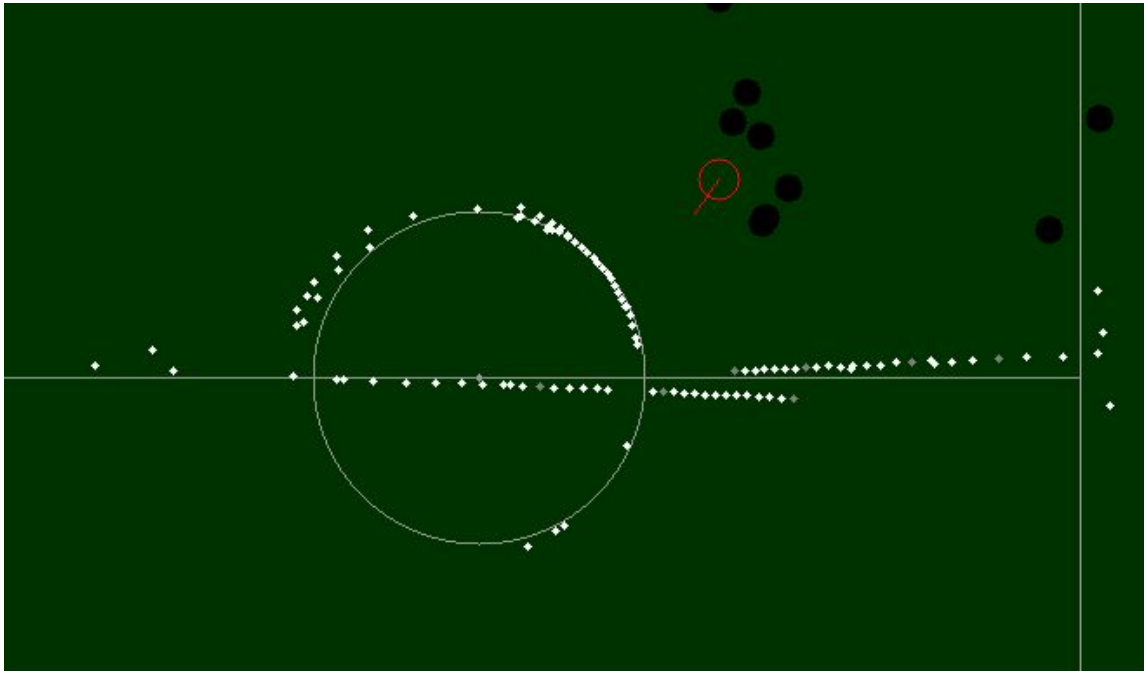
- **localization**
- ball detection
- obstacle detection

Localization requires information from **all** 4 cameras



Vision Synchronization Problem Statement

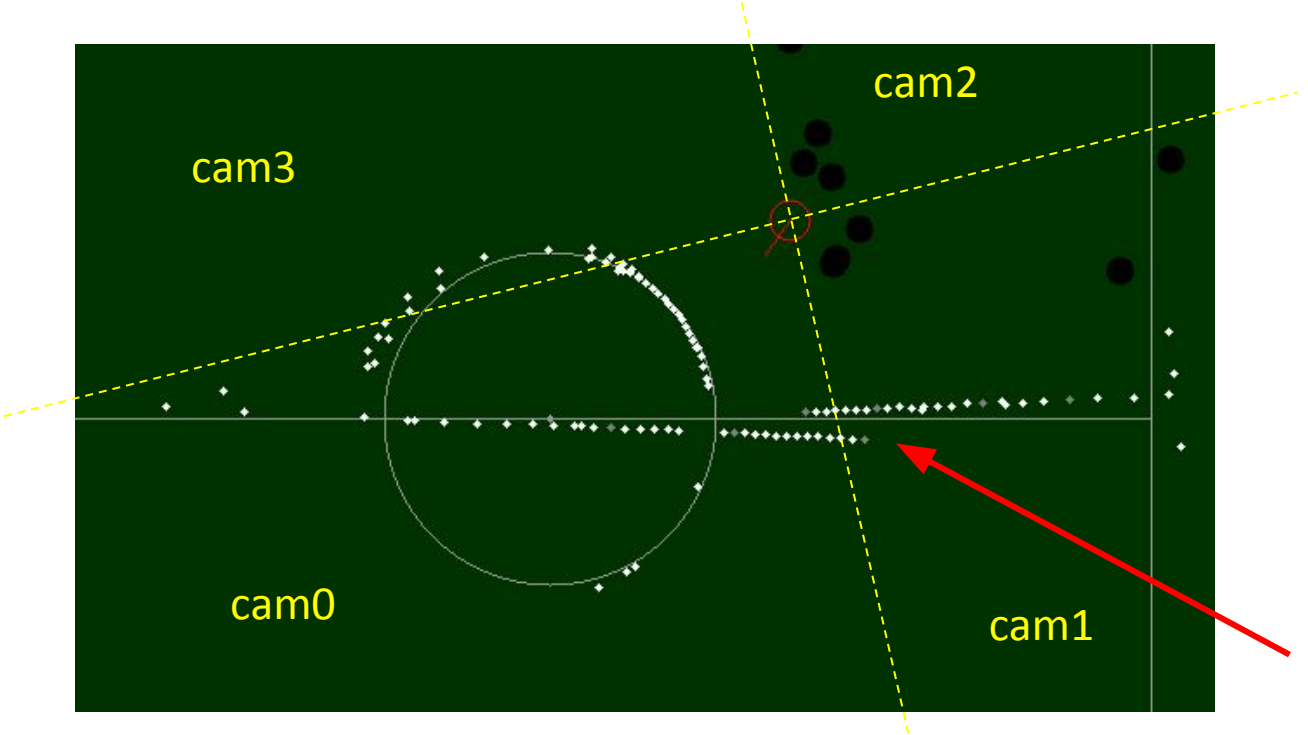
Image displacement when captured on different time when **moving**



top view

Vision Problem statement

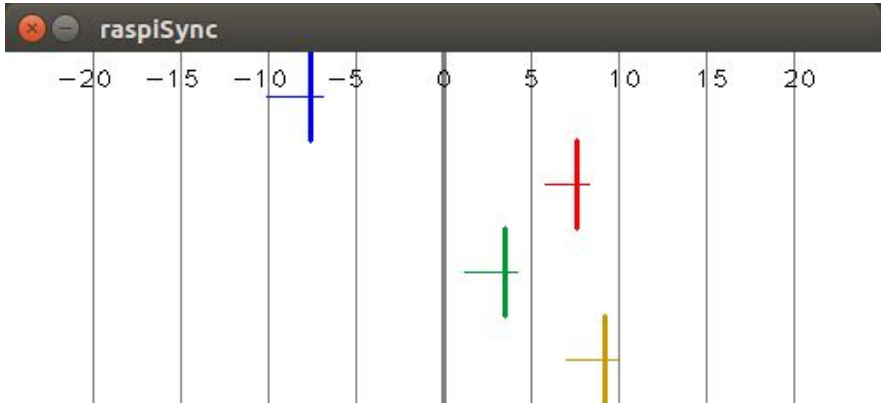
Image displacement when captured on different time when **moving**



Vision Synchronization Numbers

driving 5 m/s (18km/h)
acceptable error 6.5cm (line width 13cm)
acceptable delta time 0.065/5 = 13ms

rotating 1 turn in 2 second (180 deg/sec)
acceptable angle error 2 deg
acceptable delta time 2/180 ~= 11 ms



rolling shutter
- 10 ms (for region of interest)

camera captures at 40 frames per second (FPS)
- capture delta time between cameras maximal 25 ms

Vision Synchronization Target

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Synchronize capture delta time from 25 ms to less than 5 ms

Vision Synchronization Scenarios

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higher FPS

NO: limited by Raspberry PI

start/stop cameras in controlled way

NO: video stream interrupted / difficult to perform on correct time

change camera pixel clock

NO: pixel clock control granularity too large / limitations Raspberry Pi

slightly modify amount of pixels per line

YES: software control

slightly modify amount of lines per frame

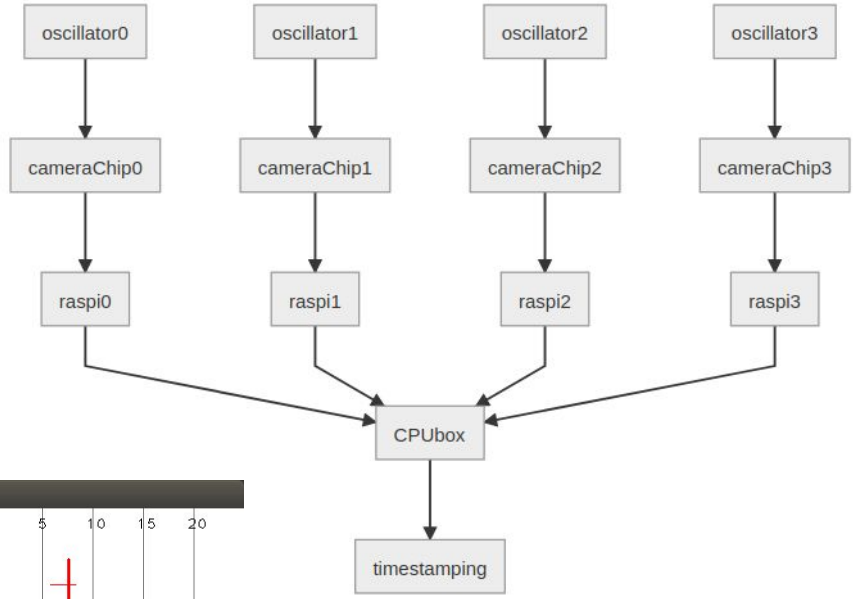
YES: software control (but larger granularity than pixels)

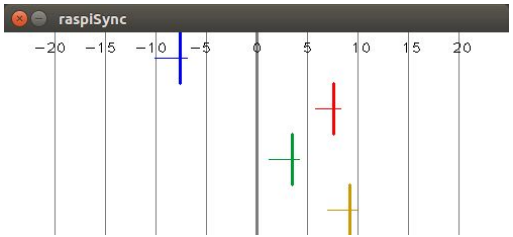
*FPS = constant * oscillator / (lines * pixels)*

Vision Synchronization Implementation

camera 0 = time reference
send start of frame to CPU box

- received after camera 0
  - remove few pixels (for short while)
- received before camera 0
  - add few pixels (for short while)
- received nearly at the same time
  - use default pixel size





make use of i2c to access camera chip

“The Plank” Synchronization Test Setup

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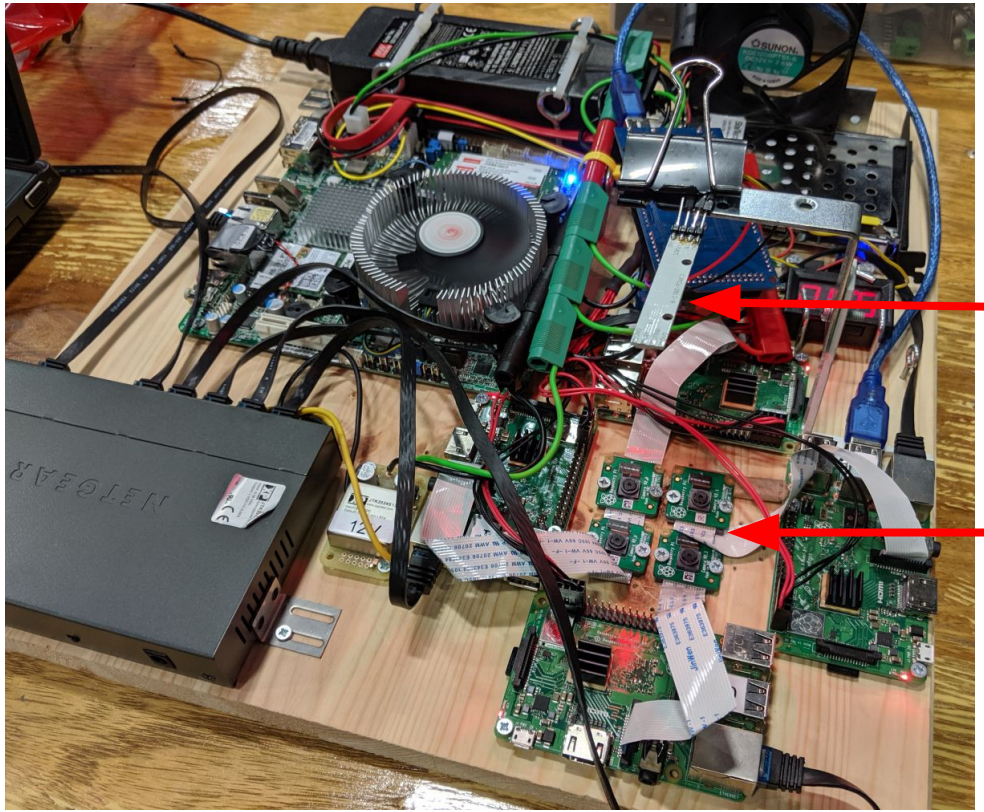
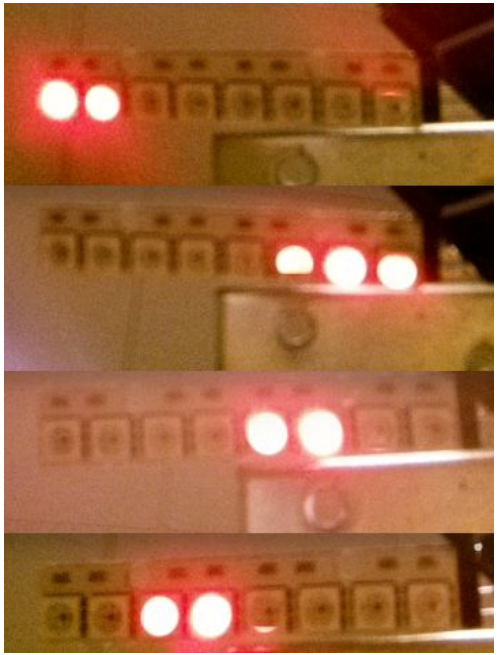


blinking lightstrip
8 LEDs * 40Hz = 320Hz

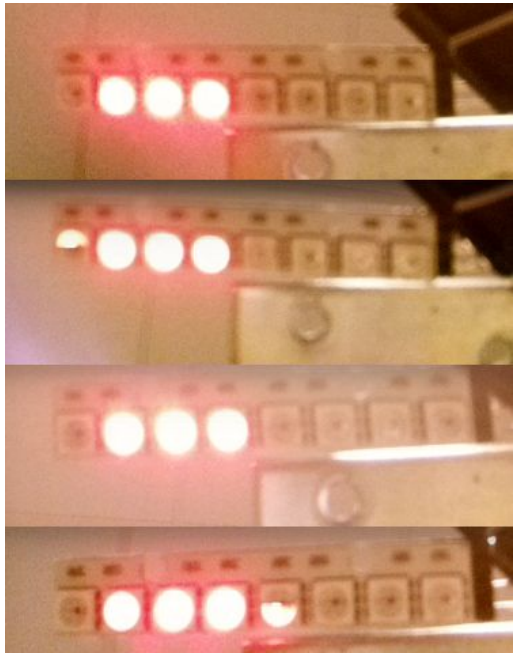
4 x Camera

Vision Result

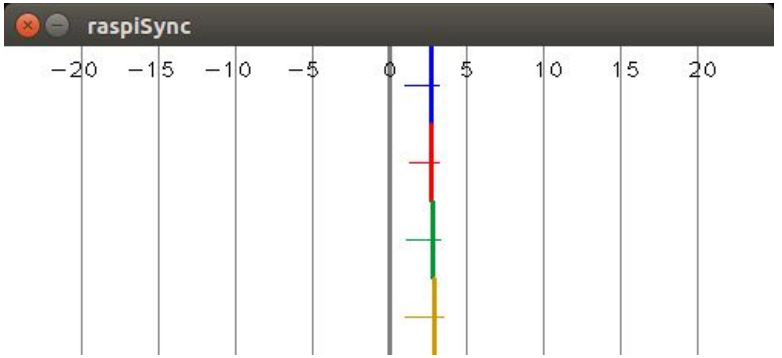
led blinking lightstrip at n * fps seen by all 4 cameras



before



after



Vision Synchronization Roadmap

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Increase frame rate
- lower impact rolling shutter

Synchronize cameras over all robots
- moving ball triangulation

Keeper extension actuators