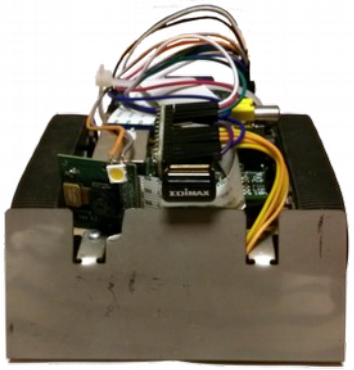
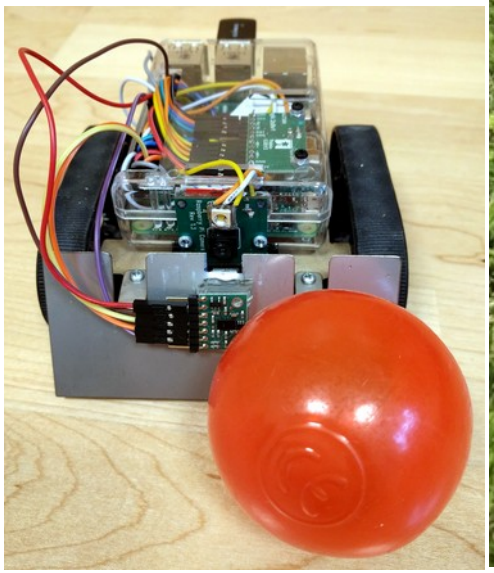
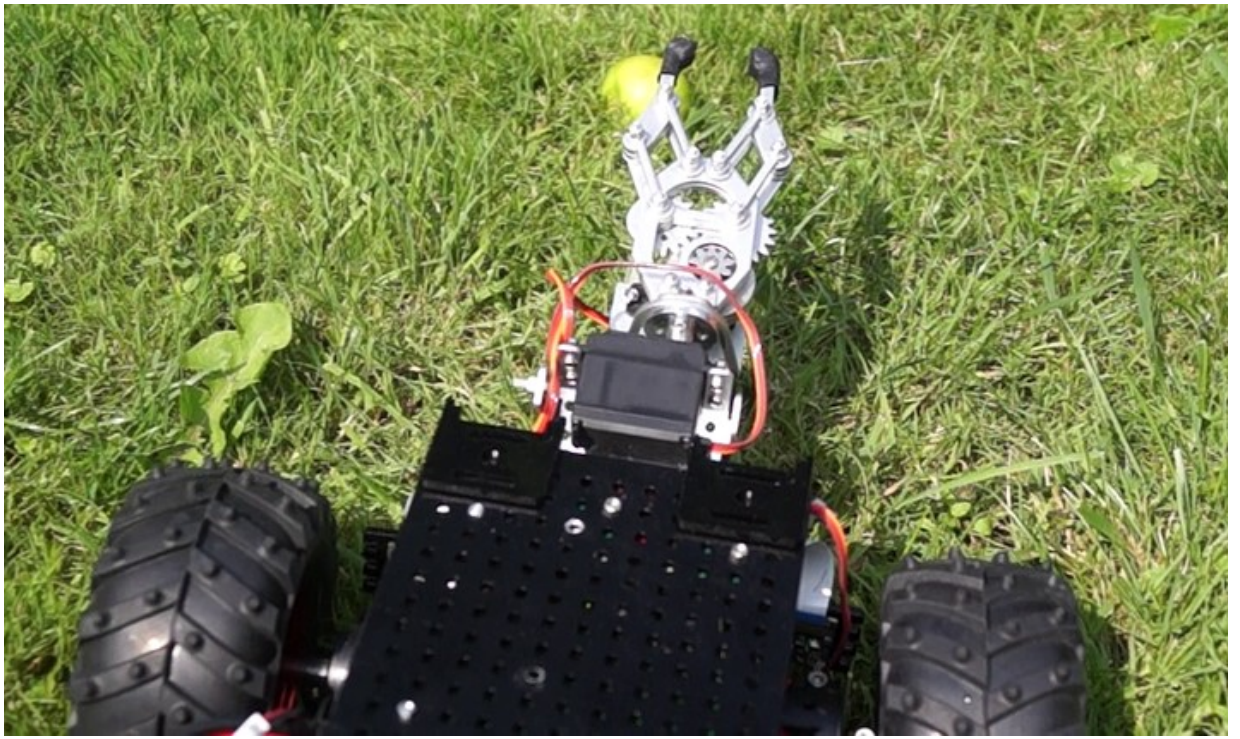
ToyCollect







An Open Source Robotic Platform

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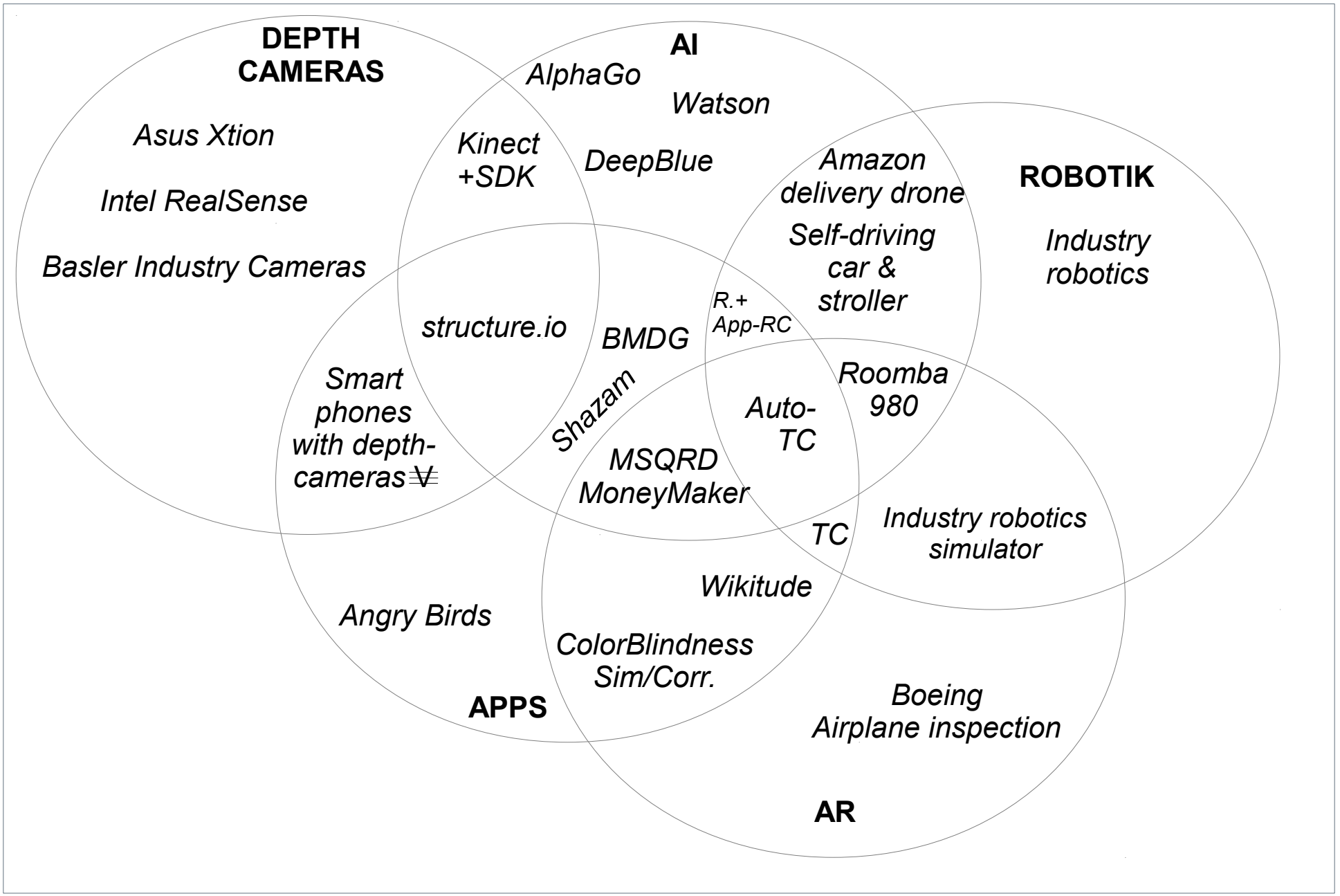

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What is ToyCollect?

Series of robots we have been building since 2014

- Open Source Software & off-the-shelf hardware
- All plans also open source
- Self-assembly (some soldering required)
- Using (at least one) camera(s)
- Controlled by (most) Android phones & tablets

Based on Raspberry Pi

- cheap (~ 25-35US$) ARM device
- low power (~ 75-125mA)
- small (large matchbox)

Use Case: Recover toys from under the couch

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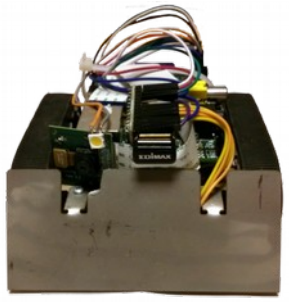
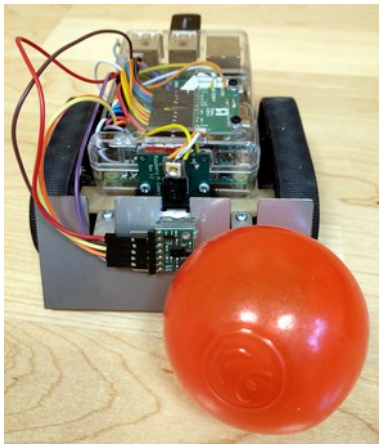
ToyCollect Generations (1)



v1.0 (2014)

- 2.4Ghz WLAN has choppy video under couch
- Camera is placed asymmetrically: hard to control
- LED too weak, range too small - too dark!



v1.1 (2016)

- 5.0Ghz WLAN - works perfectly under couch!
- Rechargable Batteries!
- New LED: now sufficient to work in darkness
- Center camera: 1.7x faster for benchmark task!
- 1.36min/toy for recovery (38min real-life test)

v2.0 (2016)

- Outdoor version for picking up fruit
- Compute module eval. kit with two camera ports
- Stereo cameras & robot arm
- Control via Google Cardboard & 2 Wii-Controllers

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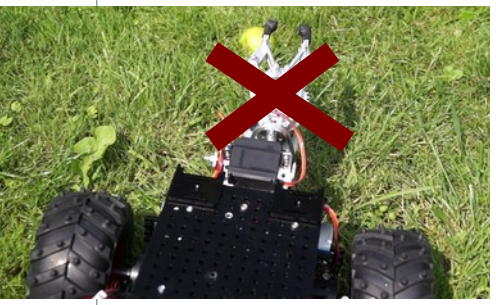
ToyCollect Generations (2)

v1.2 (2018)

- 3D-plotted chassis
- 2x RPi Zero stereo camera setup
- Just connect cables and clip in RPis....
  very fast to build



v2.1 (2017)

- Removed robot arm
- New sensors: Ultrasound distance, GPS, accelerometer, magnetometer, gyroscope
- Depth camera (Asus Xtion)
- New remote controls: via head movements, bluetooth gaming controller and traditional driving wheel/gas/brake controller

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ToyCollect is a school kid project!

Building times for prototypes until final version

- v1.0: 3 weeks (hardware & software & testing) by Georg,16yrs
- v1.1: 1 week (hardware & testing) by Diana, 17yrs
- v2.0: 2 weeks (hardware & testing) by Diana, 17yrs
- v1.2: 1 day (hardware & testing) to be validated in July

We ordered the hardware, make preliminary plans, did troubleshooting and minor software adaptations. We let our "students" solve their tasks and test robot performance.

Funded by local research agency FFG under Talente 2014-2018

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Feedback by builders

Hello! ToyCollect is really a nice Project. (*Maurizio*)

Anyways thanks for this great project my 4 year old loves to push toys out from under her bed with it (*Chad*)

Thank you for sharing your toycollect project. I really like the idea of the immediate feedback from the robot by video (*Sander*)

- **Also mentioned on the Raspberry Pi Blog**
- **Video viewed several thousand times in first week**

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Outlook

Current ToyCollect robots need an operator - but we'd like our robots to be autonomous...

- Now v2.1 and v1.2 both have stereo-cameras - Deep Learning complex behaviours has become much more feasible
- v2.1 has a depth camera as well (works when not too sunny)
- v1.2: depth camera ordered but not yet received nor installed

Update 03/2018

- Autonomous software still work in progress. However we are already collecting data for deep-learning obstacle avoidance and other behaviours, hopefully this year we will make some progress. We have some hardcoded behaviours in v2.1.
- Experimental test of conductive filament proves somewhat encouraging. We aim to embed I2C bus and power lines into the 3D-plotted chassis as an alternative to classical PCB design.

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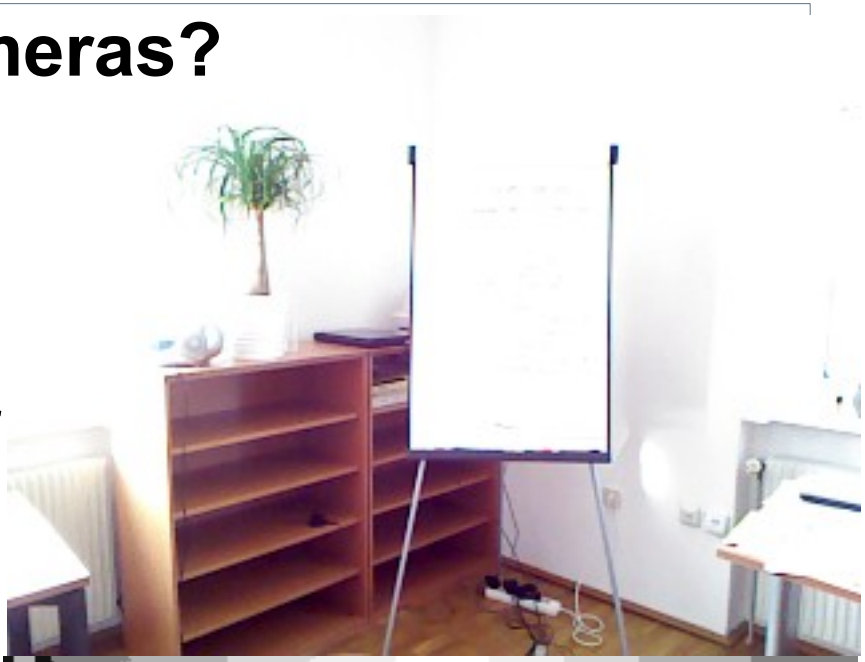
Why depth cameras?

Normal camera = *passive sensor*

- Extracts data from reflected light
- Reconstruction of depth via stereo cameras - works well if background is *structured* but only gives *sparse* depth



Depth camera = *active sensor*

- Sends out structured (near-IR) signal and analyzes reflection
- Works with any background and gives *dense* depth
- Makes hard things easy (e.g. detect, segment & track objects)

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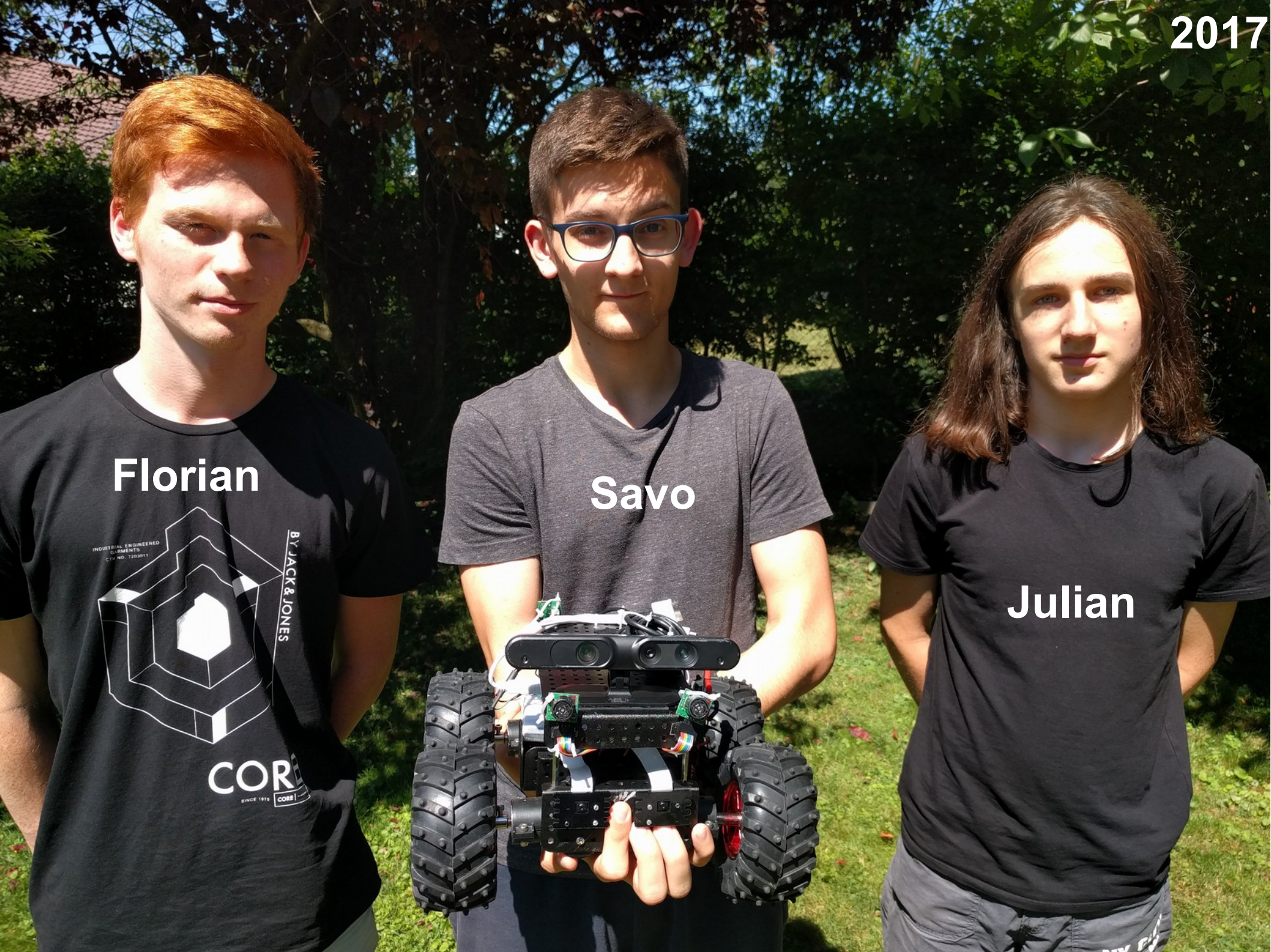
2017
Florian
Savo
Julian
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