Platform

Hardware

The challenge is built around https://www.pololu.com/product/5003. You can find plenty of information in https://www.pololu.com/docs/0J86.

At a glance, the robot is based around the RP2040 microcontroller, which is the first own silicon released by Raspberry Pi, and packs a bunch of interesting features, such as a PIO (programmable IO) or USB connectivity. In terms of contact with the outside world, the robot has USB connection which can provide serial console, debugging over Serial Wire Debug (SWD), an OLED display, 5 RGB LEDs and a buzzer to help you in debugging your code. As input one can find three buttons, and 2 rotary encoders attached to the wheels, 5 downward facing reflectance sensors, and 2 forward facing for bumper detection. Finally, the robot also has two inertial measurement units.

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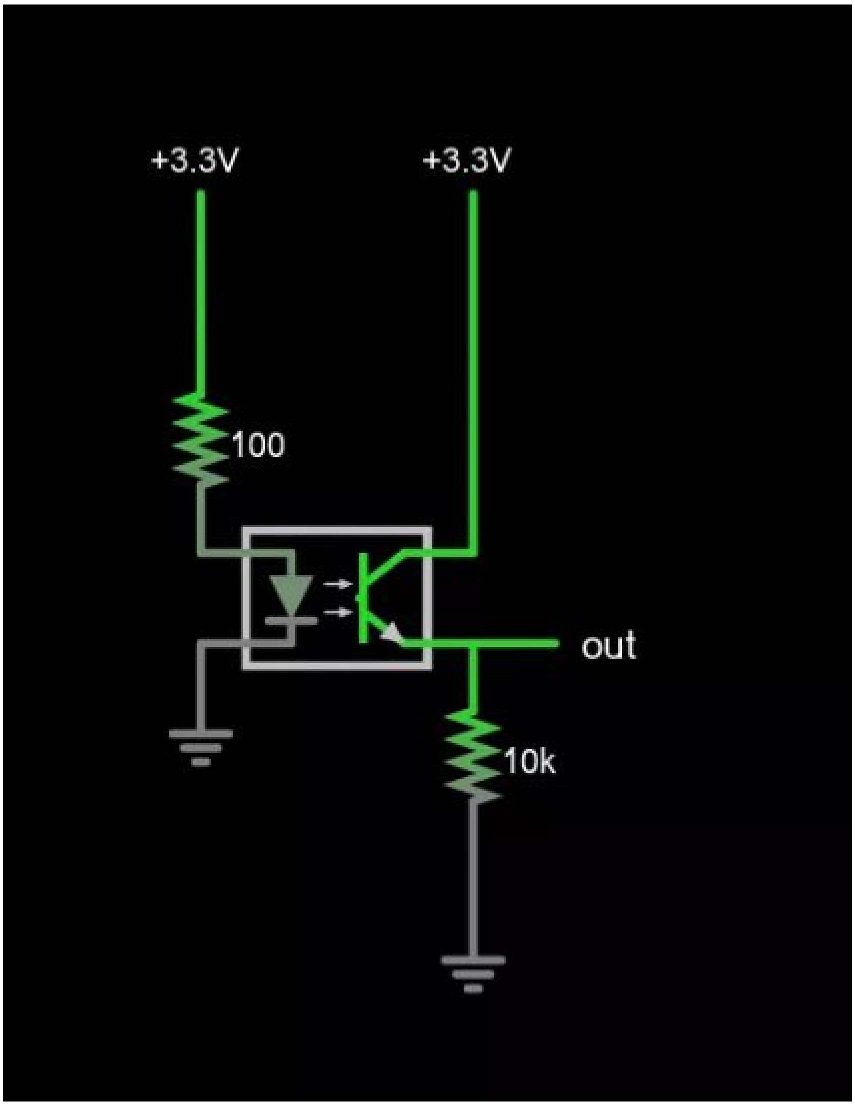
In summary:

- MCU: RP2040
- Input:
  - 2 encoders
  - 3 buttons
  - 7 reflectance sensors
  - 2 inertial measurement units
- Output
  - display
  - RGB LEDs
  - buzzer

External components

The participants are provided with the following additional components:

- Time of Flight (TOF) sensor: VL6180X
  - We are using this module: https://cdn-learn.adafruit.com/downloads/pdf/adafruit-vl6180x-time-of-flight-micro-lidar-distance-sensor-breakout.pdf
  - This is a digital (I2C) sensor which provides distance measurements in millimeters.
  - Caveat: the bus address of the sensors on startup is hard-coded. If one wishes to connect more than one sensor on the same bus, then the shutdown pin of all of them but one has to be held low, then the address of the active sensor can be changed via software. In this way, the sensor(s) which have already a new address can be kept on, while the rest are turned on one by one as their addresses are changed.
- Infrared LEDs and fototransistors
  - These two can be combined for an analog distance measurement.
  - Example circuit:



- GPIO extender (I2C): PCF8574

Software

The platform we chose has support from MicroPython, C/C++ and Rust.

Python and C(++): https://github.com/pololu/pololu-3pi-2040-robot

Rust: https://github.com/SCingolani/rp-hal-boards/tree/pololu-threepi-plus-2040 (`rp-hal-boards/boards/pololu-3pi-plus-2040/`

Useful links

https://www.youtube.com/watch?v=ZMQbHMgK2rw