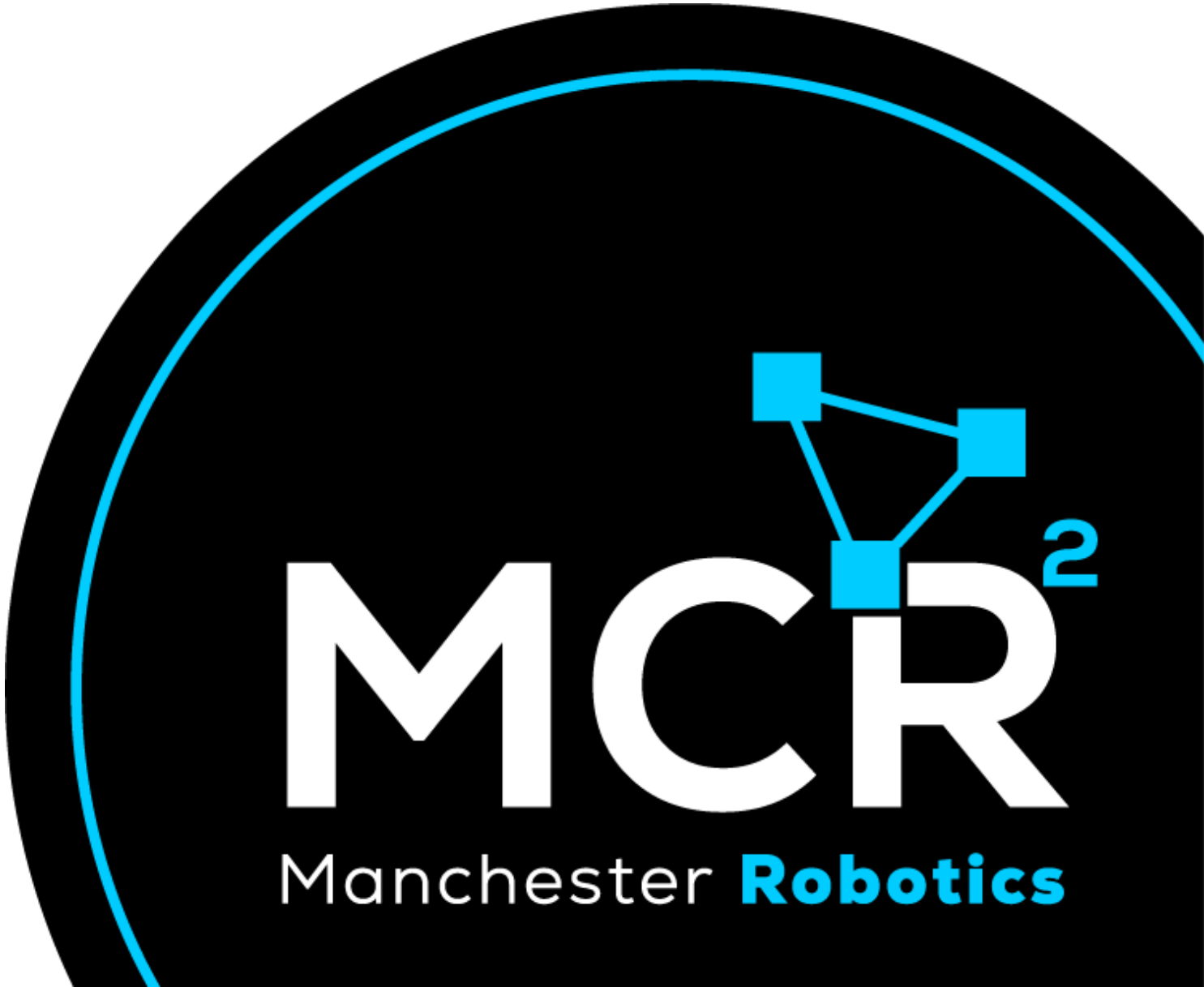
{Learn, Create, Innovate};

Puzzlebot configuration

Robot setup, motion, and control



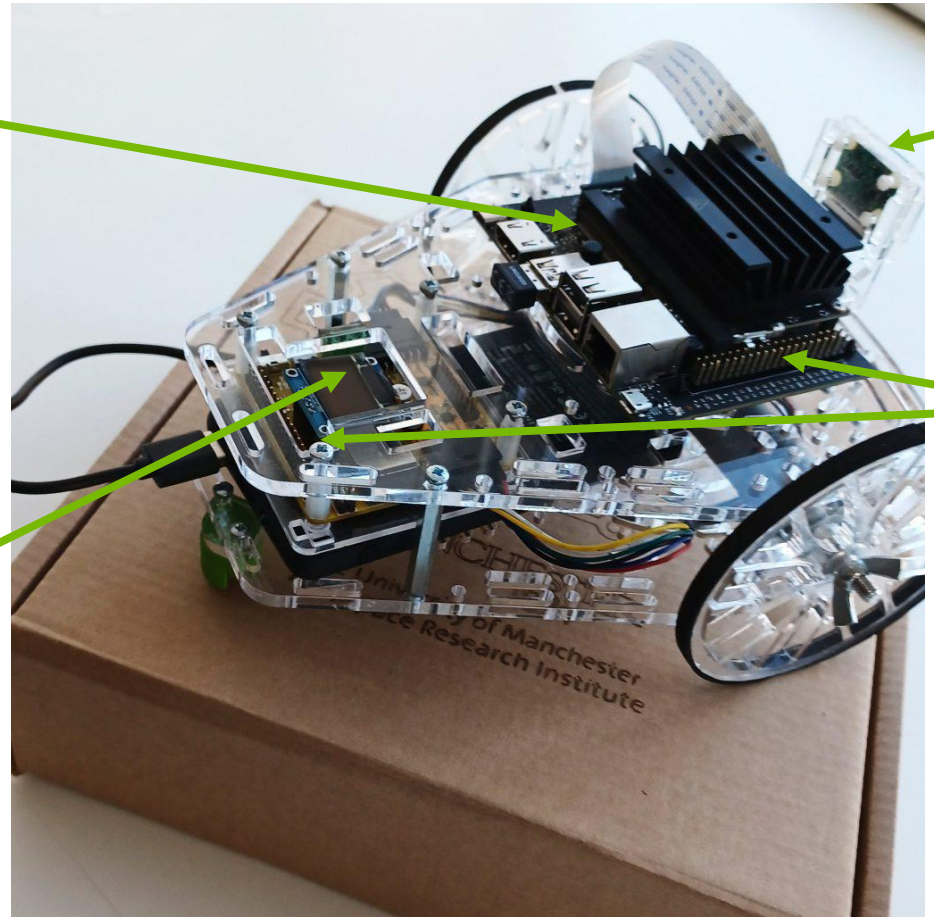
Puzzlebot: Jetson Edition

NVIDIA Jetson Nano

For AI and computer vision

Hacker Board

For low-level control algorithms

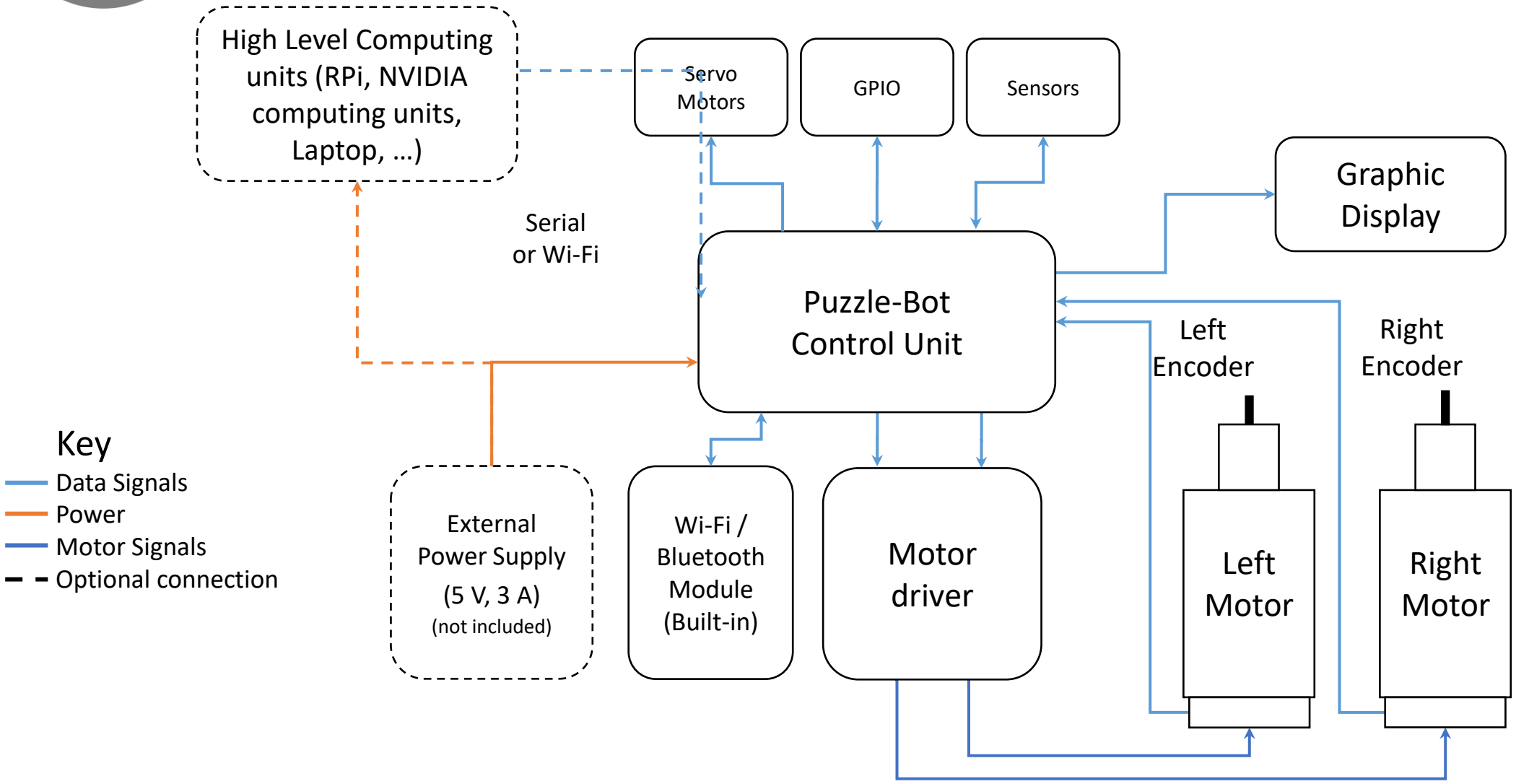


Raspberry Pi Camera

GPIO Arrays

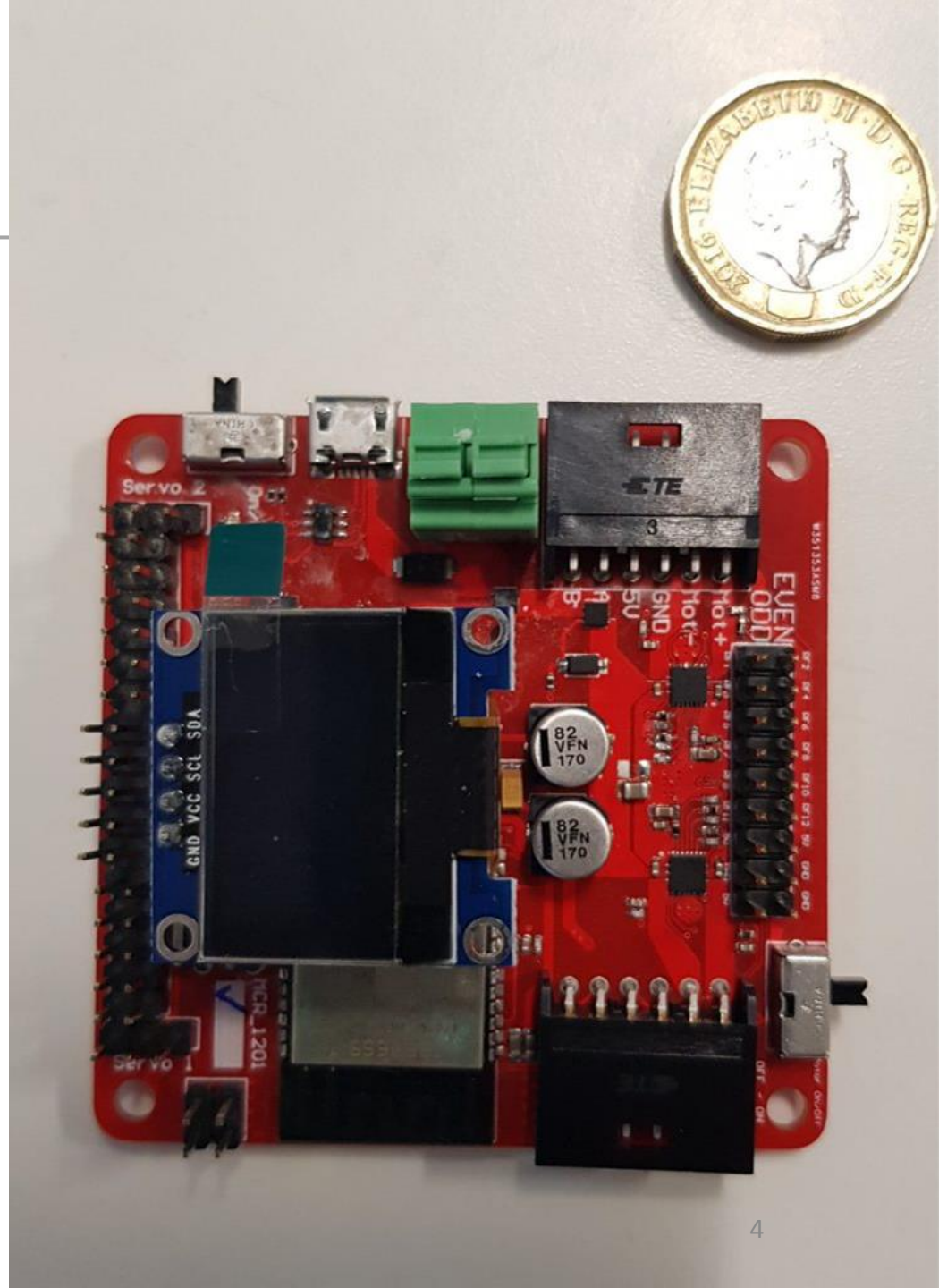
Expansion possible via the Jetson or the Hacker Board

The PuzzleBot



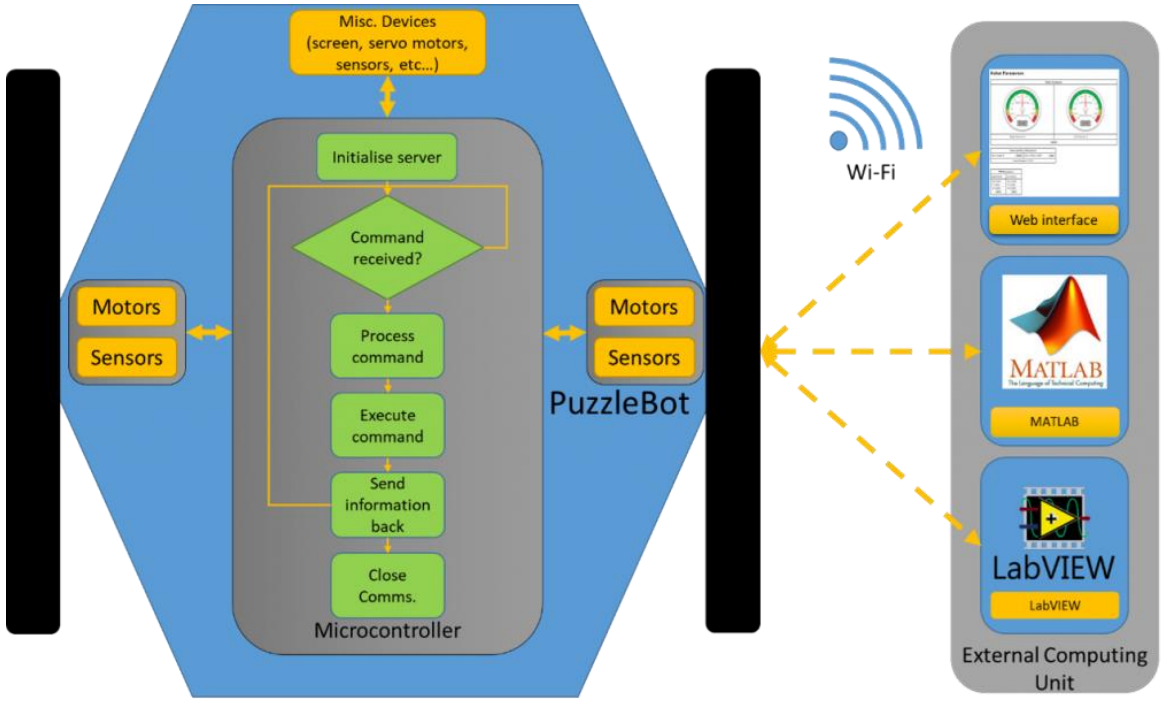
The Hacker Board

- ESP32-based Microcontroller
  - Xtensa dual-core 32-bit LX6 microprocessor
  - 520 KB of SRAM
  - WiFi & Bluetooth
- DC-DC Converter
- Motor Driver
- 0.96” I2C LCD Display



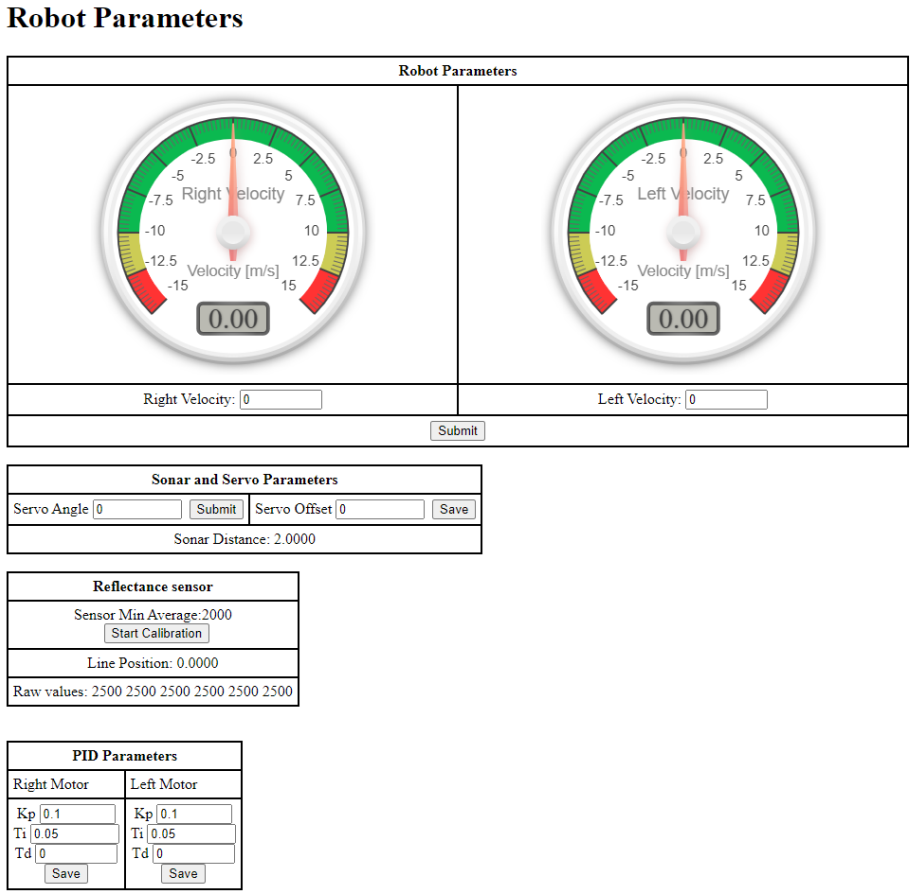
The Hacker Board

- Preprogramed firmware including basic control, sensing, and communication libraries
- Two programming configurations:
  - Standalone Configuration
  - External-Control Configuration



The Webpage

- Connect to the WiFi Network displayed on the Hacker Board
- Go to 192.168.1.1 in a browser



The Config

Now visit

192.168.1.1/config

Configuration parameters for the robot ("config.yaml" file)

Upload to robot | Restart robot

```
# Config file for puzzlebot with pololu brushed dc motors

PidDt: 0.01                    # Pid controller loop sampling time

# Main parameters for the robot
Robot:
  Type: 1                      # 1-differential drive robot; 2-holonomic robot
  ControlInput: 2              # 1-robot linear and angular velocities; 2-wheel angular velocities setpoints; 3-wheel pwm voltage signals
  WheelBase: 0.083             # Half of the robot width
  WheelRadius: 0.0505          # Wheel radius
  TopicVx: VelocityLinearX     # Topic for receiving linear velocity of the robot
  TopicVy: VelocityLinearY     # Topic for receiving linear velocity of the robot on Y(for holonomic robot)
  TopicW: VelocityAngular      # Topic for receiving angular velocity of the robot

# Parameters for the right wheel
RightWheel:
  Motor:                # Right motor parameters
    Pins: [4, 15, 18]           # Motor driver pins
    Sign: -1                    # Motor direction setting (-1/1)
    Type: 2                     # Motor type. 1-brushless; 2-brushed
    Topic: ControlR             # Topic for receiving control pwm
  Encoder:              # Right encoder parameters
    Pins: [34, 36]              # Encoder pins
    Sign: 1                     # Encoder direction setting (-1/1)
    Ticks: 48                   # Encoder number of ticks for one rotation
    Gear: 34                    # Gear ratio
    Type: 2                     # Encoder type. 1-single pulse(no direction); 2-double pulse(with direction)
    MeasureType: 1              # Encoder velocity measurement type. 1-count pulses; 2-measure pulse duration
    Topic: VelocityEncR         # Encoder velocity publish topic
  Pid:                  # Right Pid controller parameters
    Kp: 0.1                     # Proportional gain
    Ti: 0.05                    # Integration time
    Td: 0                       # Derivation time
    DeadZone: 0.1               # Motor control dead zone
    Topic: VelocitySetR         # Topic for receiving velocity setpoint

# Parameters for the left wheel
LeftWheel:
  Motor:                # Left motor parameters
    Pins: [2, 14, 13]           # Motor driver pins
```

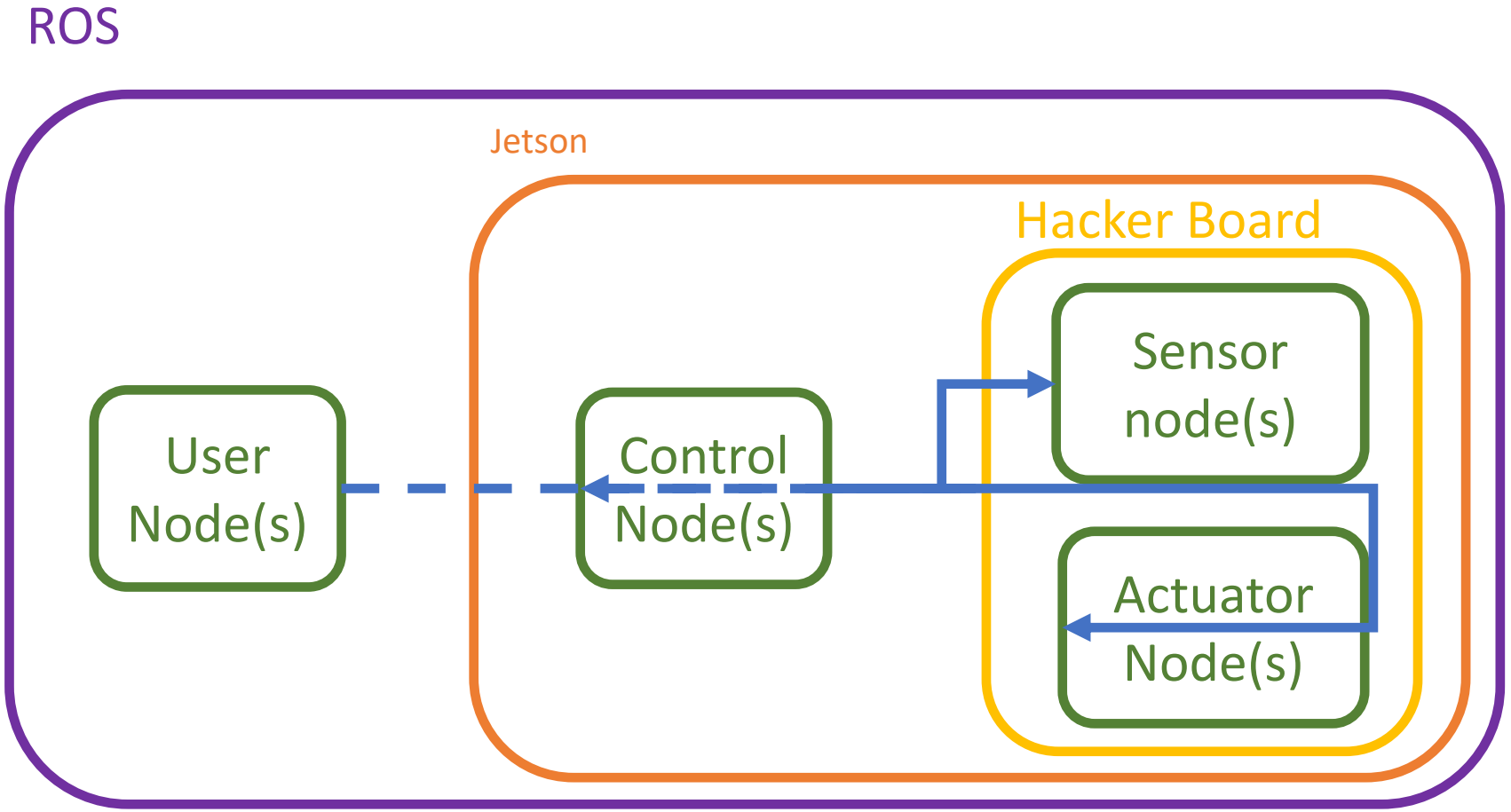
The Jetson Nano 2GB

- 128-core NVIDA Maxwell GPU
- 1.43 GHz Quad-core ARM A57 CPU
- 2 GB of 64-bit LPDDR4 Memory
- SD card for storage
- Ethernet & WiFi
- CSI-2 Connector for Camera
- Runs a modified version of Ubuntu 18.04

The Jetson Nano 2GB

- Communicates with the Hacker Board serially via micro-ROS
- Runs NVIDIA's own version of Linux, similar to Ubuntu
- The OS is flashed onto the SD card by a PC
- Three options for setup
  - Use the provided image in place of the NVIDIA image (recommended)
  - Run a setup bash file
  - Manual installation

The Jetson Nano with ROS



ROS Implementation

Activity Teleoperation

- Setup a PuzzleBot Jetson:
  - Get Started With Jetson Nano Developer Kit | NVIDIA Developer
  - Use the image provided in the git
- Install the ROS teleop twist keyboard package on an external PC
  - sudo apt install ros-humble-teleop-twist-keyboard -y
- Connect to the Puzzlebot via ssh
  - The Jetson will create its own WiFi network that can be used to communicate with it
  - Name: PuzzlebotJetson
  - Password: Puzzlebot72
    - The WiFi details can be changed on the Jetson by selecting:
    - Networks->Edit Connections->Hotspot
  - ssh puzzlebot@10.42.0.1

Activity: Teleoperation

- Once connected, run the micro-ROS agent
  - ros2 run micro-ros-agent micro-ros-agent serial –dev /dev/ttyUSB0
- use ros2 topic list to check if the connection has been successful
  - The topics /cmd_vel, /wr, and /wl should be displayed, along with a few others
- Use the external device to remotely operate the puzzlebot
  - ros2 run teleop_twist_keyboard teleop_twist_keyboard.
  - Follow the instructions displayed in the command window

Twist Message

- geometry_msgs/Vector3 linear
  - float64 x
  - float64 y
  - float64 z
- geometry_msgs/Vector3 angular
  - float64 x
  - float64 y
  - float64 z

- Publish on the node using ros2 topic pub

Thank You

Robotics For Everyone

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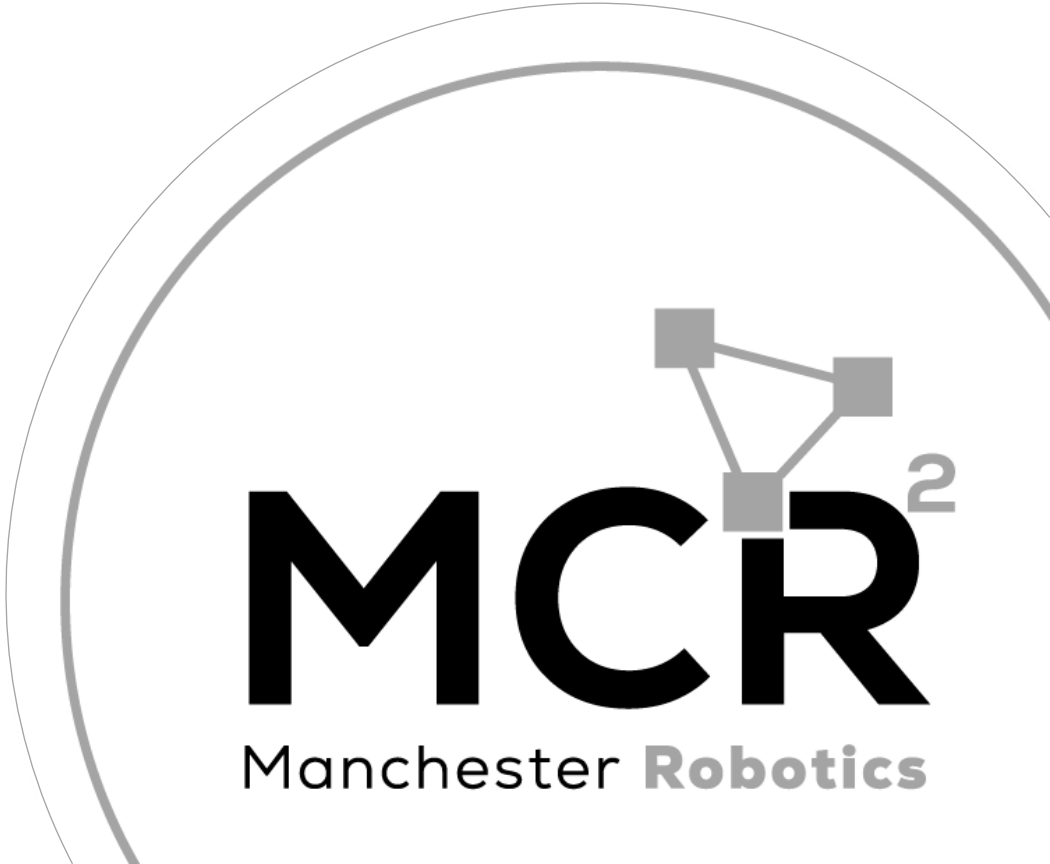
T&C

Terms and conditions

{Learn, Create, Innovate};



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