

Homework 1 - Robotic Components

Chassis & Hardware

Chassis

- <https://husarion.com/manuals/rosbot-manual/#hardware-guide>
- Built with 1.5mm thick aluminum
- Wheel diameter: 85mm
- Ground clearance: 22mm
- Max velocity: 1.25 m/s
- Max angular velocity: 420 deg / sec
- Max load: 10kg

Batteries

- Data source: <https://www.batteryjunction.com/18650.html> and <https://husarion.com/manuals/rosbot-manual/#hardware-guide>
- 3x 18650 Lithium-Ion rechargeable batteries
- Slightly larger than a AA battery
- Typically these support 300-500 charge cycles
- 3500 mAh capacity @ 3.7V nominal = ~13 Watt hours

Effectors / Actuators

4 DC motors (Xinhe Motor XH-25D Motor used: RF-370)

- Data source: <https://husarion.com/manuals/rosbot-manual/#hardware-guide> and https://xinhe-motor.en.alibaba.com/product/60555829278-220554253/XH_25D_From_XinHe_Directly_best_quality_cheap_custom_robot_gear_motor.html
- Each motor drives its own wheel
- 6V nominal operating voltage
- Stall torque: 2.9 kg*cm
- Includes encoder (see sensors section)
- Gear ratio: ~34
- Permanent magnet construction

Sensors

Orbbec Astra RGBD camera

- Data source: <https://orbbec3d.com/product-astra-pro/>
- Color and depth image resolution: 640x480px @ 30fps
- 0.6m - 8m range (presumably this is max range for depth sensing)
- Light sensitivity: Not available
- Field of view: 60°H x 49.5°V x 73°D
- Power consumption: 2.4W
- Contains 2 builtin microphones for stereo audio input
- USB 2.0 interface
- <2.4W power consumption

IMU Sensor (MPU-9250)

- Data source: <https://www.invensense.com/wp-content/uploads/2015/02/PS-MPU-9250A-01-v1.1.pdf>
- Combines accelerometer, gyroscope, magnetometer
- Gyroscope: measures rotation in x, y, z axes.
- Gyroscope: 16 bit range output is programmable to be between ± 250 deg / sec to ± 2000 deg / sec
- Gyroscope: supports sleep mode with 8 μ A current (negligible power draw on sleep)
- Accelerometer: 3 axis, 16 bit range output is programmable to be between $\pm 2g$ to $\pm 16g$
- Accelerometer: supports low power mode. Can do ~ 1 Hz updates with only 8 μ A power draw & supports wake on motion
- Magnetometer: 3 axis, hall-effect magnetic sensor
- Magnetometer: 14bit output data resolution
- Magnetometer: Full scale measurement range is $\pm 4800\mu T$
- IMU supports reading data from external sensors via I2C bus (unclear if this is incorporated into builtin inertial computations or simply passed through)
- IMU incorporates temperature sensor
- IMU supports integrated processing / detection of gestures, enabling processing offload from main CPU. (unclear how flexible these gestures can be).

Infrared distance sensor (VL53L0X Time-of-Flight distance sensor)

- Data source: <https://www.pololu.com/file/0J1187/VL53L0X.pdf>
- Quantity: 4.
- Per pictures, these seem to be mounted at each corner of the robot with 2 pointing forward and 2 pointing backwards.
- Wavelength: 940nm (infrared).
- Max reading distance: 2m. Independent of target reflectance

- Uses I2C communication w/ programmable address
- 2.6-3.3V operating voltage

Wheel-mounted encoders

- Data source: <https://husarion.com/manuals/rosbot-manual/#hardware-guide>
- Resolution: 48 pulses per revolution (12 poles). Results in 7.5 deg detection angle
- 85mm wheel diameter, so pulse for every 5.56mm of forward / backwards motion (assuming no slipping)

LIDAR (RpLidar A2)

- Data source: <https://www.slamtec.com/en/Lidar/A2>
- Rotate for 360 deg view
- Max range: 8m, 12m, or 18m (sources conflict)
- 8000 samples per second
- Runs at 10Hz (so, 800 samples per scan?)
- 1 deg angular resolution
- 0.2 cm distance resolution

Controller

CORE2-ROS w/ ASUS Tinker board computer

- Data for CORE2-ROS
 - Data source: <https://store.husarion.com/products/core2-ros>
 - 4 DC motor ports each w/ quadrature encoder interface
 - 6 servomotor interface with selectable output voltage level
 - 42 x GPIO, 4 x UART, 3 x I2C, 1 x SPI, 1 x CAN, 13 x ADC, 8 x interrupt input
 - STM32F4 microcontroller for real-time use. (168 MHz, 192 KB RAM, 1MB Flash)
- Data for ASUS Tinker Board Computer
 - Data source: <https://www.asus.com/us/Single-Board-Computer/Tinker-Board/>
 - Processor: quad core ARM processor (Rockchip RK3288)
 - RAM: 2GB LPDDR3 (dual -channel)
 - GPU: ARM-based Mali-T764
 - Storage: supports SD3.0
 - Network: supports up to 802.11n and gigabit LAN
 - Supports Bluetooth 4.0 + EDR
 - Audio: 24 bit / 192 kHz audio with S/PDIF output and microphone in
 - 40-pin GPIO interface
 - 1 DSI MIPI connection for displays / touchscreens
 - 1 CSI MIPI connection for computer vision cameras (probably not used by the Orbbec Astra b/c that's USB)