Introduction

SentiBotics robot proportions

Catterpilar chassis (x2):
• width(Cx) - 40 mm
• length between axis(Cy) - 210 mm
• height(Cz) - 105 mm

Containment box (x2):
• width(Bx) - 200 mm
• length (By) - 250 mm
• height(Bz) - 70 mm

Camera stand:
• height(Pz) - 500 mm

SentiBotics robot hardware overview
Specifications

Intel NUC

Robot contains Intel NUC D53427RKE motherboard.

Features:

- 8GB of RAM
- 60GB SSD storage unit
- Intel Core i5-3427U CPU
- Integrated Intel HD Graphics 4000 card

Chassis and motors

Robot’s caterpillar chassis is driven by two Faulhaber motors.

Features:

Motor:

- Model: Faulhaber 2342L012CR
- Power: 17W
- Working Voltage: 12 V
- Torque 1.72Nm
- Speed at unload: 8100rpm/120rpm (after gear reduction)
- Current at unload: 75mA
- Current at stall: 1400mA
- Gear ratio: 1 / 64
- Gear box: Metal

Encoder:

- Type: Optical
- Encoder Phase: AB
- Encoder Resolution: 12CPR
Motor controller

SentiBots robot is equipped with Pololu Dual VNH5019 motor controller.

Features:

- Motor driver: VNH5019
- Motor channels: 2
- Minimum operating voltage: 5.5 V
- Maximum operating voltage: 24 V
- Continuous output current per channel: 12 A
- Peak output current per channel: 30 A
- Current sense: 0.14 V/A
- Maximum PWM frequency: 20 kHz
- Reverse voltage protection: Yes

Slave controller

Features:

- Model: Teensy 3.1
- CPU: Cortex-M4, 96MHz
- RAM: 64kB
- EEPROM: 2kB
- Digital I/O: 34
- Analog Input: 21
- Analog Output: 1
- Timers: 12
- Communication: USB, Serial, SPI, I2C, CAN Bus, I2S Audio
Battery

Features:
- Type: LiFePO4
- Voltage: 12V
- Capacity: 20Ah
- Dimension: 150*168*50mm (L*W*H)
- Cycle Life: About 1200 Cycles
- Charge Temperature: 0-45 °C
- Discharge Temperature: 20-55 °C

Camera

Features:
- Model: ASUS Xtio PRO LIVE
- Color image resolution: 1280x1024
- Depth map resolution: 640x480
- Framerate: 60fps
- Effective range: 0.8m - 3.5m
- Field of view: 58°x 45°x 70°
- Connection: USB2.0

Ultrasonic Rangefinder

Two ultrasonic rangefinders (MB1030 LV-MaxSonar-EZ3) are integrated into the robot. Rangefinders are used for obstacle avoidance.

Features:
- Resolution of 1 inch
- 20Hz reading rate
- 42kHz Ultrasonic sensor measures distance to objects
- RoHS Compliant
- Read from all 3 sensor outputs: Analog Voltage, RS232 Serial, Pulse Width
- Virtually no sensor dead zone, objects closer than 6 inches range as 6 inches
- Maximum Range of 254 inches (645 cm)
- Operates from 2.5-5.5V
- Low 2.0mA average current requirement
- Narrow beam and good side object rejection
- Best for large object detection applications
Charging Station

Charging station consists of two parts. Charging stand and electrodes mounted on the front of the robot. Electrodes are connected with a battery.

Features:

- Charger Voltage: 12V
- Charger current: 4A

Current sensor

A current sensor is used to monitor battery charging.

Features:

- Manufacturer: POLOLU
- Type of sensor: current
- Supply voltage: 4.5...5.5V DC
- Integrated circuit: ACS714
- DC current measuring range: -5...5A
- Current measuring sensitivity: 0.185V/A
- Board dimensions: 17.8x20.3mm
The Intel® Movidius™ Neural Compute SDK (Intel® Movidius™ NCSDK) enables rapid prototyping and deployment of deep neural networks (DNNs) on compatible neural compute devices like the Intel® Movidius™ Neural Compute Stick.

The NCS connects to the host machine over a USB 2.0 High Speed interface.

## Wiring

### Chassis control wiring

<table>
<thead>
<tr>
<th>Teensy pin</th>
<th>Motor controller</th>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>M1EN</td>
<td>PIN_RIGHT_ENABLE_DIAG</td>
<td>Right motor - enable, diagnostic</td>
</tr>
<tr>
<td>1</td>
<td>M1INA</td>
<td>PIN_RIGHT_IN_A</td>
<td>Right motor - forward</td>
</tr>
<tr>
<td>2</td>
<td>M1INB</td>
<td>PIN_RIGHT_IN_B</td>
<td>Right motor - backward</td>
</tr>
<tr>
<td>3</td>
<td>M1PWM</td>
<td>PIN_RIGHT_PWM</td>
<td>Right motor - PWM</td>
</tr>
<tr>
<td>14</td>
<td>M1CS</td>
<td>PIN_RIGHT_CURRENT</td>
<td>Right motor - current sensing</td>
</tr>
<tr>
<td>4</td>
<td>M2EN</td>
<td>PIN_LEFT_ENABLE_DIAG</td>
<td>Enable left motor, diagnostic</td>
</tr>
<tr>
<td>5</td>
<td>M2INA</td>
<td>PIN_LEFT_IN_A</td>
<td>Left motor - forward</td>
</tr>
<tr>
<td>6</td>
<td>M2INB</td>
<td>PIN_LEFT_IN_B</td>
<td>Left motor - backward</td>
</tr>
<tr>
<td>9</td>
<td>M2PWM</td>
<td>PIN_LEFT_PWM</td>
<td>Left motor - PWM</td>
</tr>
<tr>
<td>15</td>
<td>M2CS</td>
<td>PIN_LEFT_CURRENT</td>
<td>Left motor - current sensing</td>
</tr>
</tbody>
</table>

### Sensor wiring

<table>
<thead>
<tr>
<th>Teensy pin</th>
<th>Motor controller</th>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Left Encoder</td>
<td>A</td>
<td>LEFT_ENCODER_A</td>
</tr>
<tr>
<td>8</td>
<td>Left Encoder</td>
<td>B</td>
<td>LEFT_ENCODER_B</td>
</tr>
<tr>
<td>10</td>
<td>Right Encoder</td>
<td>A</td>
<td>RIGHT_ENCODER_A</td>
</tr>
<tr>
<td>11</td>
<td>Right Encoder</td>
<td>B</td>
<td>RIGHT_ENCODER_B</td>
</tr>
<tr>
<td>23</td>
<td>IMU</td>
<td>Vcc</td>
<td>-</td>
</tr>
<tr>
<td>18</td>
<td>IMU</td>
<td>SDA</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>IMU</td>
<td>SDL</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>Red button</td>
<td>-</td>
<td>PIN_RED_BUTTON</td>
</tr>
<tr>
<td>17</td>
<td>Blue button</td>
<td>-</td>
<td>PIN_BLUE_BUTTON</td>
</tr>
<tr>
<td>A14</td>
<td>Ultrasound Right</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A6</td>
<td>Ultrasound Left</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>22</td>
<td>Battery Voltage</td>
<td>-</td>
<td>PIN_BATTERY_VOLTAGE</td>
</tr>
</tbody>
</table>

**Power circuitry wiring**

Power distribution circuit includes switches and fuses for these 3 most important robot’s blocks:

- Main controller (Intel NUC)
- Robotic arm (Not used)
- Chassis motor controller

Main power fuse is hidden next to the battery, inside the chassis box. So, to be able to change the fuse minor disassembling is required.

Nominal fuse overcurrent values listed bellow:

- Main power fuse - 15A
- Robotic arm fuse - 5A (Not used)
- Motor controller fuse - 8A
Intel NUC Panel wiring

Control pins of Intel NUC are wired to robot’s back panel. It includes turn on/off, restart buttons and indicator LED. Power LED is listed as L2, Hard Drive Activity LED - L3, Power Button - BT2, Reset Button - BT3.

<table>
<thead>
<tr>
<th>SW2</th>
<th>Main power switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
<td>Arm power switch (Not used)</td>
</tr>
<tr>
<td>SW0</td>
<td>Chassis power switch</td>
</tr>
<tr>
<td>BT3</td>
<td>Intel NUC reset button</td>
</tr>
<tr>
<td>BT2</td>
<td>Intel NUC power button</td>
</tr>
<tr>
<td>BT1</td>
<td>Programmable button A, default action - switch on/off robotic arm torque (Not used)</td>
</tr>
<tr>
<td>BT0</td>
<td>Programmable button B</td>
</tr>
<tr>
<td>L3</td>
<td>Intel NUC status indicator</td>
</tr>
<tr>
<td>L2</td>
<td>Intel NUC power indicator</td>
</tr>
<tr>
<td>L1</td>
<td>Arm power indicator</td>
</tr>
<tr>
<td>L0</td>
<td>Chassis power indicator</td>
</tr>
<tr>
<td>F1</td>
<td>Arm power fuse (5A)</td>
</tr>
<tr>
<td>F0</td>
<td>Chassis power fuse (8A)</td>
</tr>
<tr>
<td>S0</td>
<td>Battery charging socket</td>
</tr>
</tbody>
</table>