# Hardware

Ein Bild, das Diagramm enthält.

Automatisch generierte Beschreibung

|  |  |  |
| --- | --- | --- |
| **Pin** | **GPIO** | **Function** |
| 3 | GPIO 2 | I2C SDA |
| 5 | GPIO 3 | I2C SCL |
| 11 | GPIO 17 | M1\_Other |
| 12 | GPIO 18 | M2\_Other |
| 16 | GPIO 23 | M1\_Dir |
| 18 | GPIO 24 | M2\_Dir |
| 19 | GPIO 10 | Encoder2\_B |
| 21 | GPIO 9 | Encoder2\_A |
| 23 | GPIO 11 | Encoder2\_I |
| 24 | GPIO 8 | Reset\_IMU |
| 26 | GPIO 7 | Int1 (not used) |
| 32 | GPIO 12 | M2\_PWM |
| 33 | GPIO 13 | M1\_PWM |
| 35 | GPIO 19 | Encoder1\_A |
| 38 | GPIO 20 | Encoder1\_B |
| 40 | GPIO 21 | Encoder1\_I |

The Balance Robot is controlled by a raspberry pi 5 running raspian. An additional PCB is used to connect all the peripheral parts.

The motors are controlled by a PWM and a direction signal plus one additional signal. The IMU and the motor-current measurements are connected via I2C. The quadrature encoder signals are connected directly to some GPIOS of the pi.

There are some LEDs to easily see if the Battery is low. The green LED is a simple power-on led. The red LED signals that the battery is getting low. When the red LED turns on, please save all your work, shutdown the pi and disconnect the battery. (If you are only programming and the robot doesn’t need to move, there may be some lab-power-supplies available.)

# Software

To test all parts there are test scripts available. They should also help you get started.

The I2C Devices have the following addresses:

|  |  |  |
| --- | --- | --- |
|  | **Address hex** | **Address bin** |
| **ADCs:** | 0x4B | 1001011 |
|  | 0x4D | 1001101 |
|  |  |  |
| **IMU:** | 0x28 | 0101000 |

The current measurement has the factor 316.5 /A. (That means a motor-current of 1A will produce a digital value of ~317)

The IMU settings and behaviour can be read in the datasheet. The IMU can perform some sensor fusion to simplify the signal processing you have to do on the pi.

To control the motors, it is important to use the hardware PWM generator in the pi. (Software PWMs are not accurate enough.)

# Setup

Always use a battery or a lab power supply (7V - 8.5V) to power the balancebot. Do not power the robot only through the raspberry pi.

Add following line to /boot/firmware/config.txt to enable the i2c interface:

**dtparam=i2c\_arm=on,i2c\_arm\_baudrate=400000**

There may be some python libraries you’d like to use. (These are also used in the example scripts)

* smbus2
* gpiozero
* numpy
* pandas
* matplotlib

to install a library, use **sudo apt install python3-BLABLA**. (replace BLABLA with the library name)