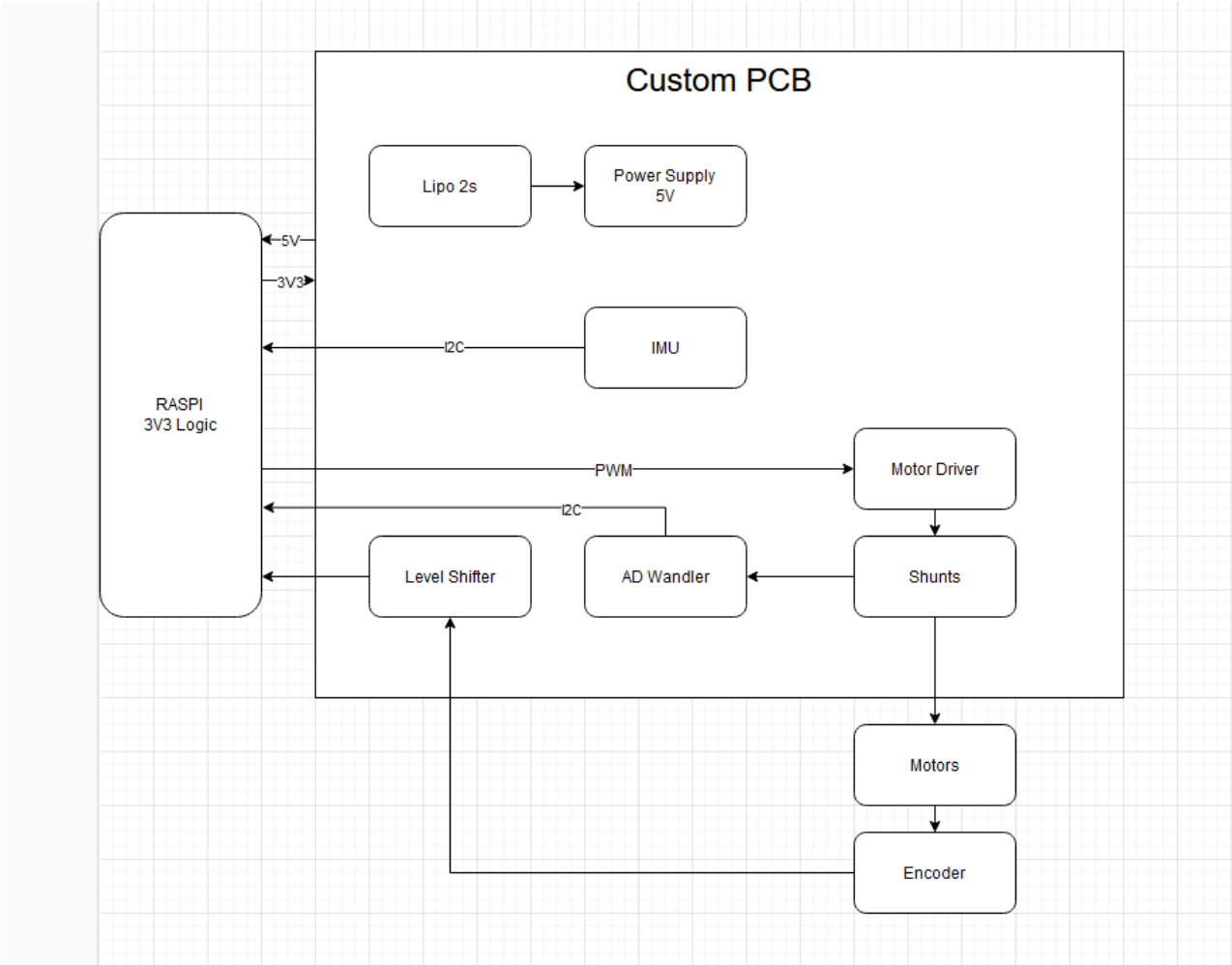
User Manual
BTE5232 – Balance Robot

Hardware



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.)

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

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)