PocketBot2

matchbox-sized robots

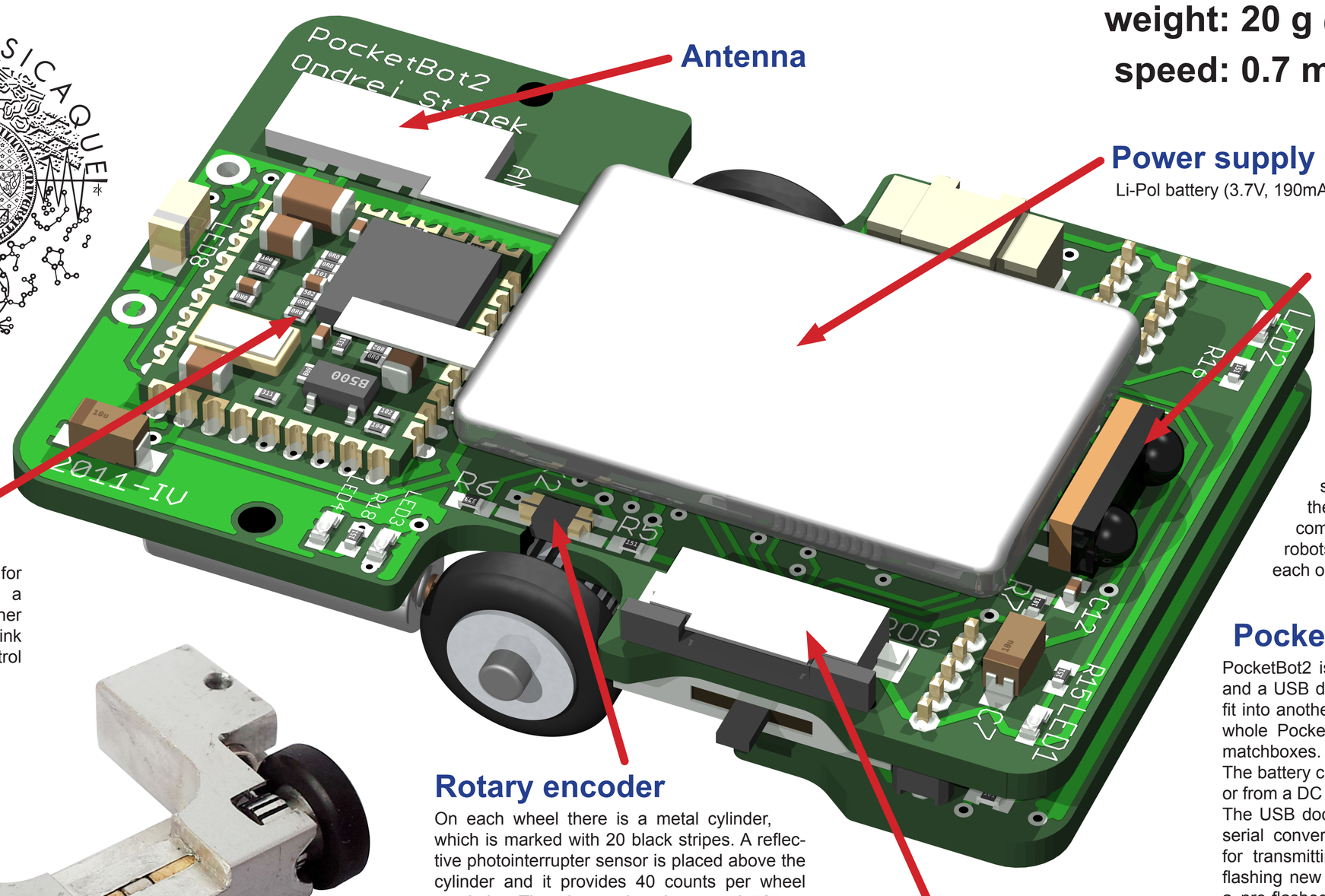
“Designed for mass production”

A tiny line following robot features bluetooth, odometry, color sensor, proximity sensors, 3-axis accelerometer, optical communication, powerful motors and more...

dimensions: 48 × 32 × 13 mm

weight: 20 g (body 16g, cell 4g)

speed: 0.7 ms^{-1} (line following)



Antenna

Power supply

Li-Pol battery (3.7V, 190mAh)

Proximity sensor

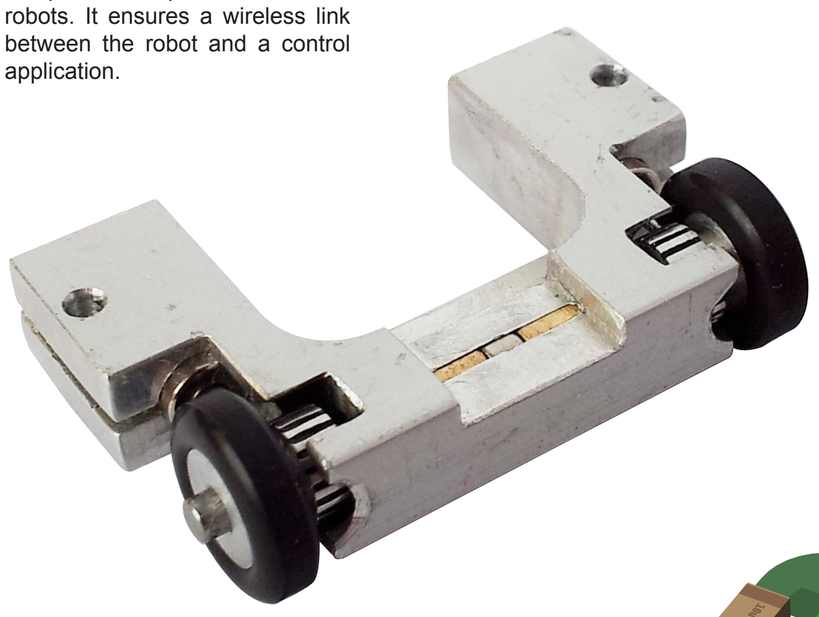
Proximity sensors use modulated infrared light for detecting obstacles. There are two such sensors in the robot; front and rear. The front sensor has three directed IR leds, so it can detect whether the obstacle is on the left, right or in the center.
Furthermore, the proximity sensors have a second function; they provide short distance infrared communication between PocketBot2 robots. It means that robots can identify each other when they meet.

Bluetooth

Bluetooth technology is used for wireless communication with a computer, cell phone and other robots. It ensures a wireless link between the robot and a control application.

PocketBot2 accesories

PocketBot2 is equiped with a battery charger and a USB docking station. These two utilities fit into another matchbox. As you can see, the whole PocketBot2 platform is packed in two matchboxes. A pocket robot indeed!
The battery charger can be powered from USB or from a DC wall adapter.
The USB docking station stands as a USB to serial converter. The serial interface is used for transmitting debuging messages and for flashing new firmware into the robot. There is a pre-flashed bootloader in the PocketBot2's microcontroller, which allows to flash new program without the need of an expensive JTAG programmer.
However, there is a common 10pin connector for JTAG and PDI onchip debugging as well.



Rotary encoder

On each wheel there is a metal cylinder, which is marked with 20 black stripes. A reflective photointerrupter sensor is placed above the cylinder and it provides 40 counts per wheel revolution. That gives an impuls per each 725µm of trajectory. In other words, the resolution of the encoder is 14 pulses per 1cm of trajectory. The odometry system ensures precise movement of the robot and it is used for localization.

Connector

A 10-pin connector offers interfaces for programming and debugging. (JTAG, PDI, UART)

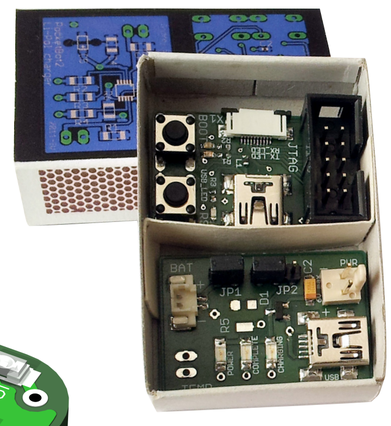
Undercarriage

Two separately driven wheels (9mm diameter) provide differential steering. Powerful motors from mini helicopter are used, which guarantees high speed performance. The dimensions of the gear mechanism were crucial due to considerable space constraints. The wheelframe employs a friction gear system with magnetic pressure. A neodymium magnet in the central tube attracts wheel axles, pressing each wheel to the motor shaft. The pressure can by adjusted by moving the wheel on its axle, i.e. by changing the distance of axle and magnet.

Magnetic presure is adjusted by changing wheel position on axle.

Microcontroller

runs robot's program written in C
Atmel ATxmega128A3, 32MHz
128kB FLASH, 8kB RAM



Line sensors

Four detectors (phototransistors) and five emitters (infra-red LEDs) are placed in a row alternately so that each phototransistor is surrounded with two IR LEDs. Thanks to this design it is possible to measure the surface reflectivity on eight spots under the sensor module.

Motors

extremly powerful motors
from mini helicopter
60.000 rpm free-runing

H-bridge

DC motor driver
allows backwards motion

Accelerometer

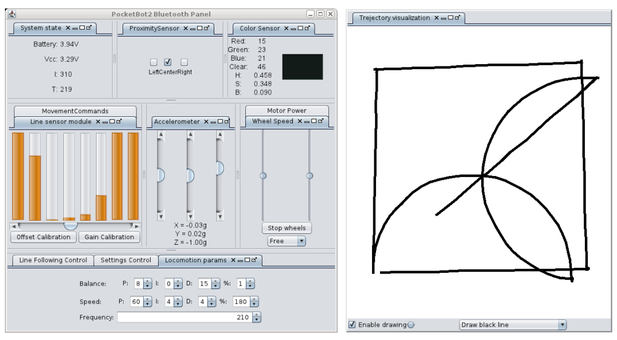
three-axis accelerometer
with 12-bit resolution

Color sensor

PocketBot2 is equiped with an RGB color sensor. The sensor is placed on the bottom of the robot, next to line sensors. It recognizes the color of the surface. The RGB sensor is employed in line following. Difficult segments of the track can be marked in red, so the robot knows it had better to slow down. In the same manner, the straight segments can be marked with a blue tape, indicating that the speed can be increased safely.

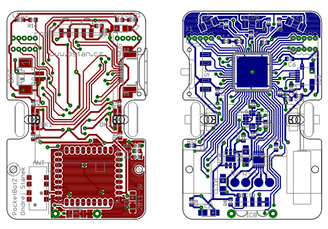
Control application

PocketBot2 is supported with a PC control application. The application allows to access all robot's sensors and modules, providing live information about the state of line sensors, color sensor, battery voltage, acceleration and others. It also offers adjusting robot settings, such as PID constants, sensor calibration and line following attributes.
The application keeps track of robot's position. The trajectory of the robot is drawn on a white canvas.



Printed circuit board

A double-sided printed circuit board stands as the robot's chassis at the same time. SMD components are used, mainly in MLF and 0402 packages.
(board is printed in real size 1:1)



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