PocketBot2

a matchbox-sized robotic platform

PocketBot2 is robotic platform of a tiny autonomous mobile robot. Its based on its ancestor, the PocketBot project [1]. The PocketBot2 brings new impressive features, though it still keeps all functions and properties of the previous version of the robot. Namely, the dimension constraints of 48 × 32 × 12 mm are preserved, so the robot fits exactly into a matchbox.

New features

- Wireless Bluetooth communication
- Wheel optical encoders (odometry)
- Optical communication between PocketBot2 robots
- H-Bridge motor control (allows backwards motion)
- Line color detection
- System monitoring (speed, acceleration, battery state..)

Functions

PocketBot2 is capable of line following. The guiding line can be marked with black and colored tape. The robot has a line color sensor, which allows to distinguish the color of the guiding line. Optionally, complicated segments of the track can be marked with a red tape and straight ones with a blue tape. Robot then decreases the speed on dangerous red parts of the track, and conversely, it increases the speed on blue parts of the track.

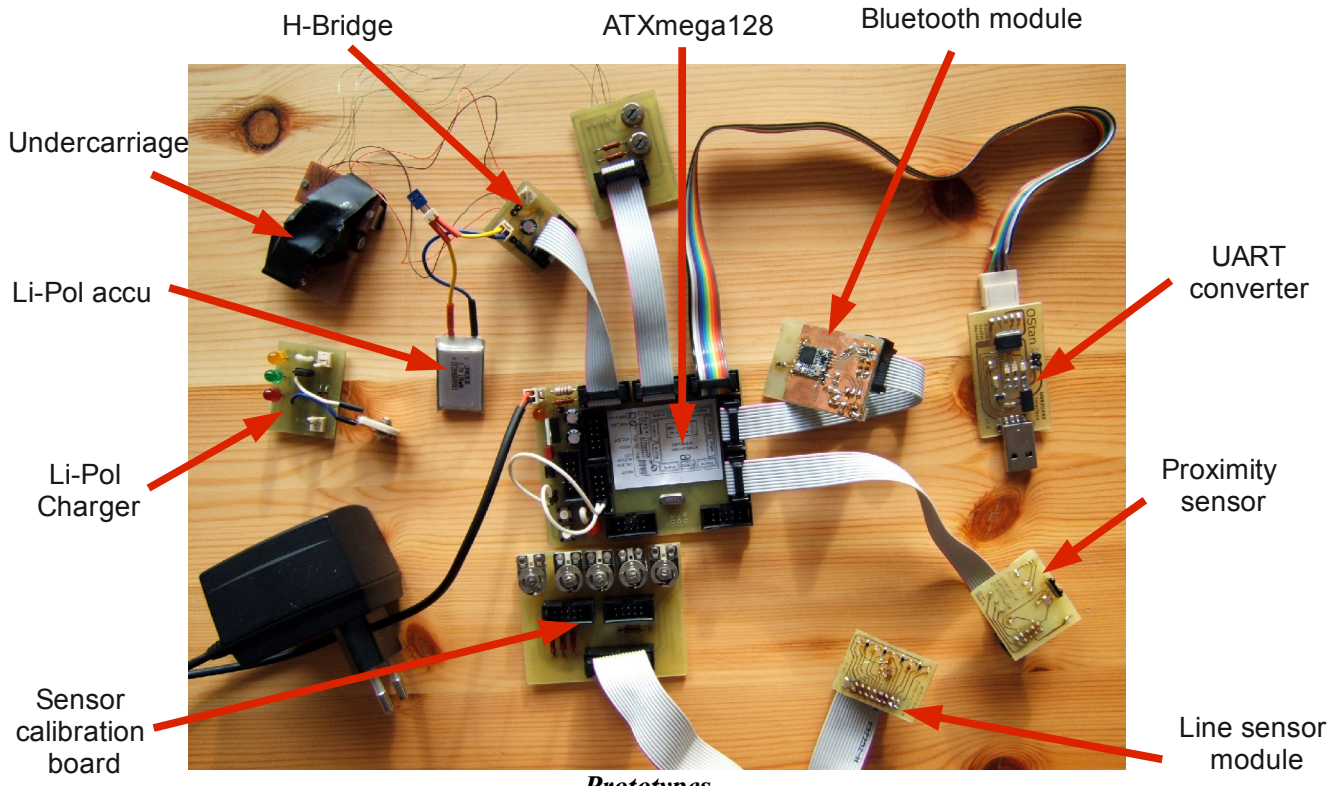
The robot is equipped with proximity sensors and odometry system, so it can avoid obstacles on the way. The odometry system provides information of current movement speed, acceleration and movement trajectory.

This information is transferred via Bluetooth L2CAP layer [7] to the PC control application and visualized. The application also provides remote control and settings adjustment. It is programmed in Java and it uses the BlueCove [2] implementation of the JSR-82 bluetooth specification, which makes the control application fully platform-independent.

Prototypes

PocketBot2 consists of several parts: Sensor module, Bluetooth module, Proximity sensors, Color detector, Undercarriage, H-Bridge and the Xmega MCU. A prototype of each part was built and tested, before it is integrated into PocketBot2. The robot itself is manufactured industrially and it is designed with respect to batch production.

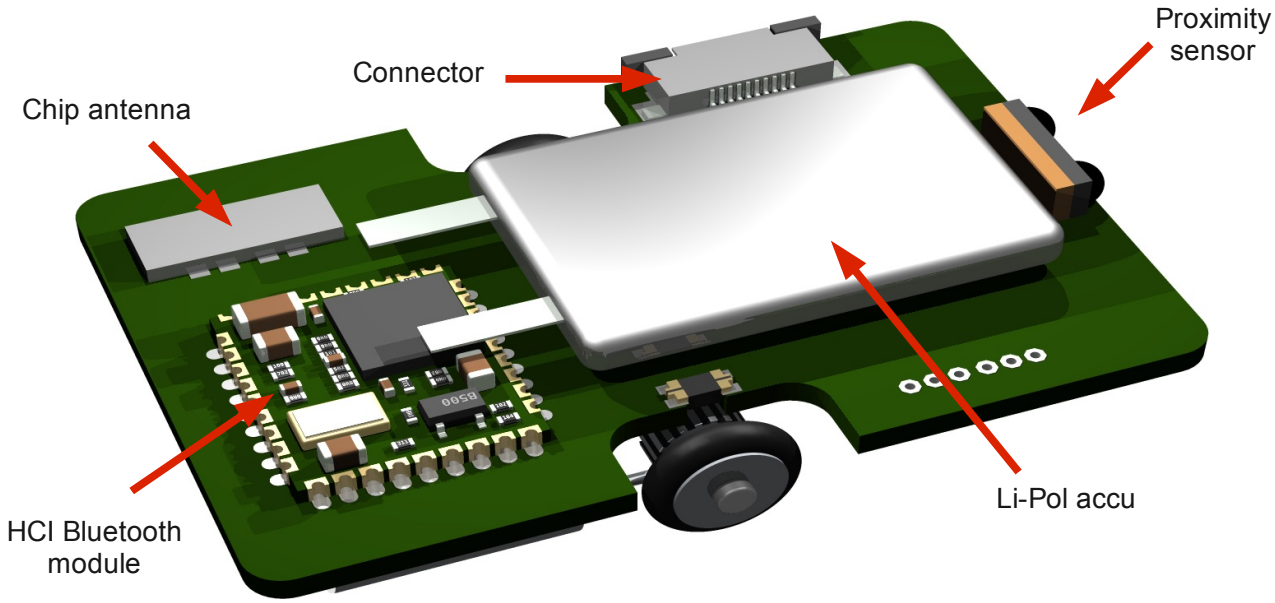
There is a development diary [4], which describes each part of the robot in detail. It is written in Czech language, however, a Google translate is available [5].



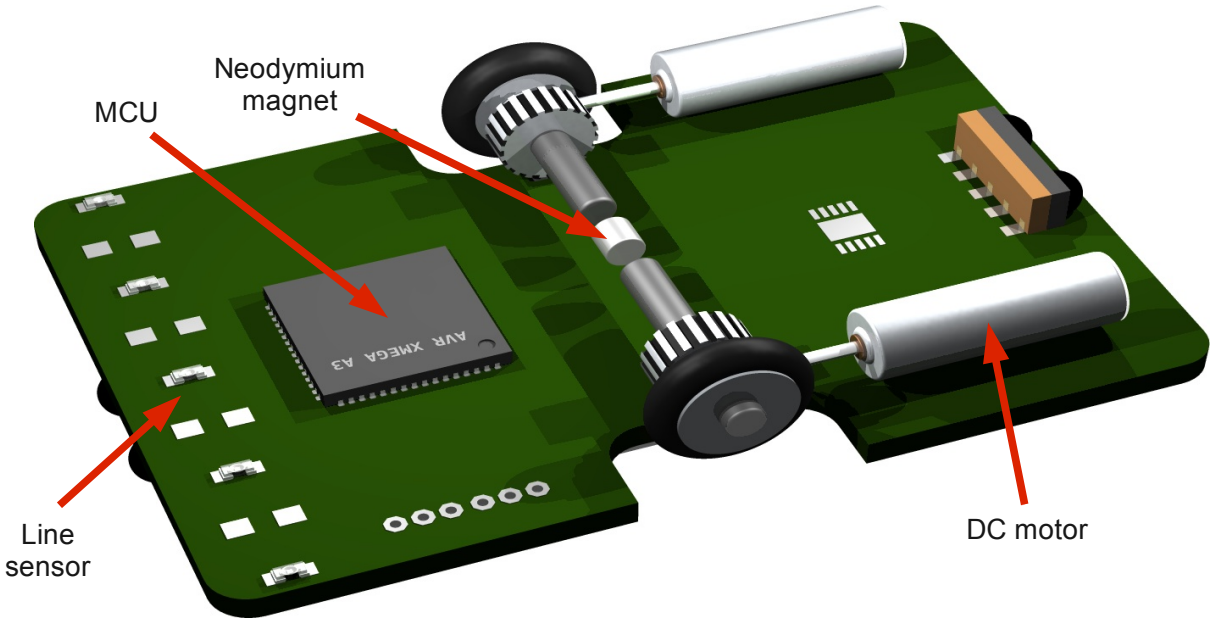
Prototypes

Construction

A double-sided printed circuit board stands as the robot's chassis at the same time. Robot is powered with a rechargeable Li-Pol battery (3.7V, 190mAh). The Atmel ATXmega128A3 microcontroller [3] runs robot's program, which is written in C. A 10-pin connector offers JTAG and UART interface for programming and debugging.



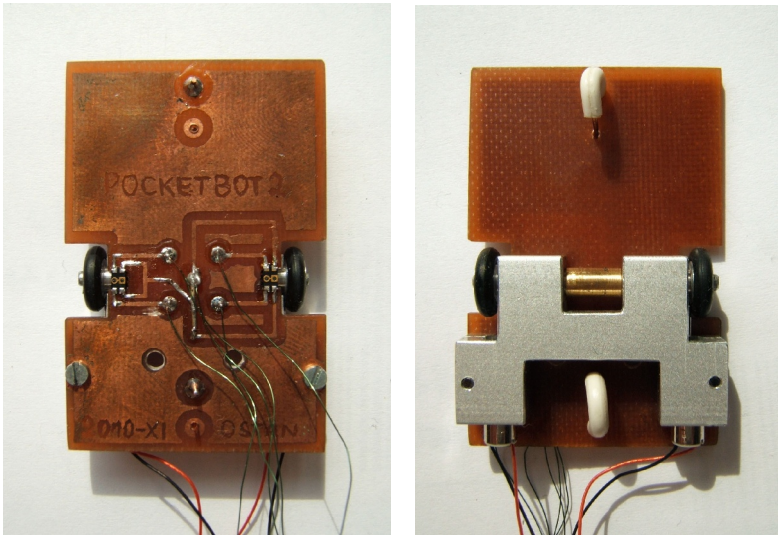
PocketBot2 - top view



PocketBot2 - bottom view

Undercarriage

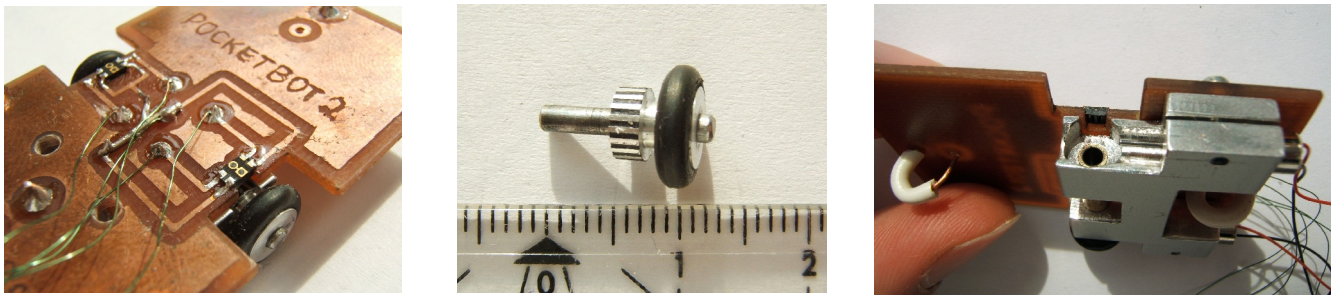
Two separately driven wheels (8mm diameter) provide differential steering. Powerful motors from mini helicopter are used, which guarantees high speed performance. The dimensions of the gear mechanism were crucial due to considerable space constraints. The wheelframe employs a friction gear system with 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.



Undercarriage prototype

Optical encoders and odometry

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 pulses per wheel revolution. That gives an encoder tick per each 625µm of trajectory. In other words, the resolution of the encoder is 16 ticks per 1cm of trajectory. The odometry system ensures precise movement of the robot and it provides information of actual speed and acceleration.



Optical wheel encoders in detail

Bluetooth

The robot is equipped with a Bluetooth HCI module. The HCI [6] Bluetooth module provides a baseband controller and link manager (i.e. the HCI module ensures only the radio layer for Bluetooth technology). That means that a Bluetooth stack must be implemented in the MCU of the robot.

Although this approach to the Bluetooth implementation is much more complex than commonly used Bluetooth RS232 serial port adapter modules, it brings considerable advantages, such as broadcasting, forming piconets and scatternets, HID profile support etc..

Author

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References

[1] The PocketBot Project http://www.ostan.cz/pocketBot/

[2] BlueCove, opensource bluetooth for Java SE http://bluecove.org/

[3] Atmel ATXmega microcontroller http://www.atmel.com/dyn/products/product_parameters.asp?category_id=163&family_id=607&subfamily_id=1965&part_id=4302&ListAllAttributes=1

[4] PocketBot2 development diary http://www.ostan.cz/PocketBot2/development_diary/

[5] http://translate.google.cz/translate?hl=cs&sl=cs&tl=en&u=http://www.ostan.cz/PocketBot2/development_diary/

[6] http://www.bluetooth.com/English/Technology/Works/Pages/Architecture__Host_Controller_Interface_HCI.aspx

[7] http://www.bluetooth.com/English/Technology/Works/Pages/Architecture__Logical_Link_Control_and_Adaptation_Protocol_L2CAP.aspx

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