BIP Embedded Systems for Mobile Robots
Challenges for Physical Component Jan. 8.-12., 2024 at Bremen

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This document defines the challenges to be conducted during the presence week. Every Team needs to assemble a two-wheel robot equipped with the following hardware components:

➢ Wemos® D1 R32 w/ ESP32 UNO R3 pinout Reference: ARD02075
➢ Cabo USB 2.0 A - Micro USB B Macho Referência :CAB01025
➢ Tracker Sensor, Infrared Line Tracking w/ cable Reference: SEN03024
➢ Microswitch with Roller Reference: CEL10060
➢ Grove Electromagnet Reference: SOL01003
➢ Micro DC Geared Motor w/Encoder-SJ01 (6V 160RPM 120:1) Reference: MOT02043
➢ ARCELI motor drive Controller Board Module
➢ 18650 Li-Ion Battery 3.7V 3200mAh Reference: BAT01063

Optionally, the following components can be added:

➢ VL53L0X Time of Flight Sensor (ToF) 940nm Compatible with Arduino
➢ EBYTE LLCC68 LoRa Wireless Serial Port Module 868MHz 915MHz 22dBm E220-900T22D
➢ ESP32 CAM ESP32-CAM-MB Development board, WLAN/Bluetooth, ESP32 DC 5V dual-core development board with OV2640 camera TF card module
➢ ARCELI 5 PIECES HC-SR04 Ultrasonic module Distance measuring transducer sensor for Arduino

Using the infrared sensor, the robot needs to be able to follow lines on the ground and to detect junctions and intersections. With aid of the microswitch sensor and the electromagnet, it can pick up magnetic boxes and deliver them at prescribed locations.
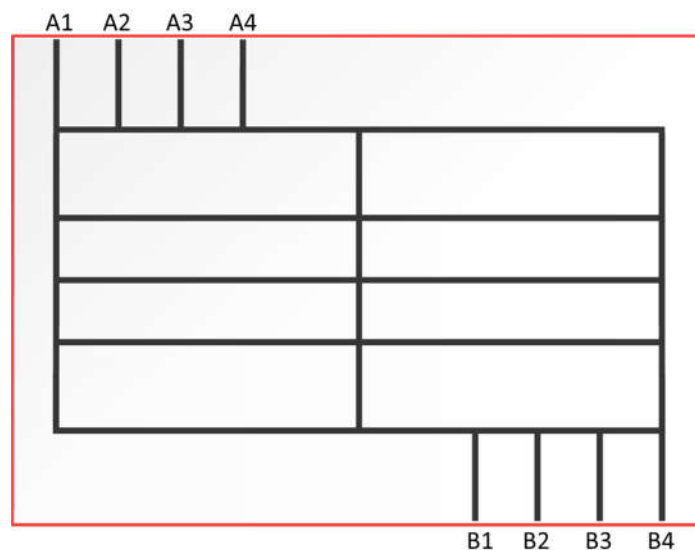
Fig. 1: A0-size maze composed of line segments used for tracking

Given is the maze depicted in figure 1. Boxes can be placed in ports A1-4 and may be delivered to B1-4. The following Challenges need to be conducted:

- ➢ Challenge 1: The robot starts at B4, picks up a box in A3 and delivers it to B1.
- ➢ Challenge 2: Same as challenge 1, but one or multiple lines are blocked with obstacles. These can either be defined by (a) hidden lines in the maze or by (b) real objects to be detected by any kind of sensor. The robot needs to find a way through the maze autonomously, only following the lines and delivering the box at the correct location. Optionally, the path can be transmitted via UDP and visualized (recommended for debugging).
- ➢ Challenge 3: Define your own challenge by submitting an exposee (1 page).

For all Challenges, the duration time is measured. Challenges 1 and 2 are mandatory, for challenge 2, either variant (a) or (b) can be chosen. Challenge 3 can be conducted to earn extra points. All challenges can additionally be conducted with the hardware-in-the loop simulator for proof of concept (recommended). Each team should develop its own concept and may not share code with other teams. The code will later be checked into AULIS for validation.

The grading is based 50% on the performance and complexity of the challenges and 50% on a technical report summarizing the implemented algorithms and hardware assembly. The report can be submitted by end of January, 2024.