BACHELOR‘S THESIS ASSIGNMENT

I. Personal and study details

Student's name: **Vlk Jan** Personal ID number: **499227**

Faculty / Institute: **Faculty of Electrical Engineering**

Department / Institute: **Department of Cybernetics**

Study program: **Cybernetics and Robotics**

II. Bachelor’s thesis details

Bachelor’s thesis title in English:

Autonomous Road Crossing with a Mobile Robot

Bachelor’s thesis title in Czech:

Autonomní přejezd silnice mobilním robotem

Guidelines:

The goal of the thesis is design, implementation and experimental verification of an algorithm for safe crossing of roads with public traffic with a mid-sized mobile robot. The student should review existing approaches to the problem and assess their suitability for use on target robotic platforms. Also, a method for evaluating performance of road-crossing algorithms should be proposed and applied. In the implementation, sensor data from color cameras, 3D lidars and public cartographic data can be used to improve performance of the algorithm.
The algorithm should also expect an input with poses and velocities of detected vehicles, although the detection itself is not a part of this thesis. Other contextual inputs can be given, like maximal or expected velocity of incoming vehicles, road type, number of lanes on the road or presence of a pedestrian crossing with or without traffic lights. Given this context and vehicle velocity data, the algorithm should be able to safely assess the situation and decide whether it is safe to cross the road in a given moment or not. In the safe case, a control algorithm should be developed that will perform the actual road crossing (with continuous checking of safety of the maneuver).
Experimental verification of the work should be done both in simulation and in a controlled real-world experiment. In the real-world experiment, the robot will not enter a real public driving road, but an experimental setup in a non-public area will be set up (in cooperation with thesis supervisor) to demonstrate behavior of the algorithm even in case of incoming traffic (which will be driven by faculty staff). Results of these experiments should be evaluated according to the proposed performance metric.

Bibliography / sources:

[1] https://wiki.openstreetmap.org
[2] J. Choi et al., "Environment-Detection-and-Mapping Algorithm for Autonomous Driving in Rural or Off-Road Environment," in IEEE Transactions on Intelligent Transportation Systems, vol. 13, no. 2, pp. 974-982, June 2012, DOI: 10.1109/TITS.2011.2179802.
[3] A. Chand and S. Yuta, "Navigation strategy and path planning for autonomous road crossing by outdoor mobile robots," 2011 15th International Conference on Advanced Robotics (ICAR), 2011, pp. 161-167, DOI: 10.1109/ICAR.2011.6088588.
[4] N. Radwan, W. Winterhalter, C. Dornhege and W. Burgard, "Why did the robot cross the road? —Learning from multi-modal sensor data for autonomous road crossing," 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2017, pp. 4737-4742, DOI:10.1109/IROS.2017.8206347.
[5] M. Colledanchise and P. Ögren Behavior Trees in Robotics and AI: An introduction, 2018, CRC Press, ISBN 9781138593732.

Name and workplace of bachelor's thesis supervisor:

Mgr. Martin Pecka, Ph.D. Vision for Robotics and Autonomous Systems FEE

Name and workplace of second bachelor's thesis supervisor or consultant:

Date of bachelor's thesis assignment: **03.02.2023** Deadline for bachelor thesis submission: **26.05.2023**

Assignment valid until: **22.09.2024**

Mgr. Martin Pecka, Ph.D.	prof. Ing. Michael Šebek, DrSc.	prof. Mgr. Petr Páta, Ph.D.
Supervisor's signature	Head of department's signature	Dean's signature

III. Assignment receipt

The student acknowledges that the bachelor's thesis is an individual work. The student must produce his thesis without the assistance of others, with the exception of provided consultations. Within the bachelor's thesis, the author must state the names of consultants and include a list of references.

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Date of assignment receipt	Student's signature