EDLRIS: European Driving License for Robots and Intelligent Systems

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Abstract. *EDLRIS is a professional and standardized system for training and certifying people in fundamental topics of Robotics and Artificial Intelligence. It was developed, implemented and evaluated within the course of an international 3-year project. This paper provides an overview of goals, methodology, training modules and preliminary results of the EDLRIS project.*

1. Introduction

Robotics and Artificial Intelligence (AI) have a big impact on the working world and on people's everyday life. An increasing number of jobs are related to Robotics and AI, resulting in a strong demand for well-trained people in these areas. In order to foster a solid understanding of sociopolitical, economical and technical aspects it is important to teach fundamental Robotics and AI concepts already prior to, or outside of university. Nevertheless, hardly any well-founded teaching approaches exist at the moment. In order to address this challenge, the *European Driving License for Robots and Intelligent Systems (EDLRIS)* was developed. It specifically focuses on teaching fundamental concepts of Robotics and AI to trainers (e.g. educators, teachers, mentors, ...) and trainees (e.g. young people, pupils, apprentices, ...) following a train-the-trainer, blended-learning approach [1].

2. Related Work

The project idea was inspired by the *European Computer Driving License (ECDL)* [2]. A lot of Robotics and AI courses are held at undergraduate or graduate level (e.g. [3]) but training and certifying people in fundamental topics of Robotics/AI outside university hardly exists. Several pre-university approaches teach only selected or very basic topics of Robotics/AI (e.g. [4]). In recent years, education organizations started to develop AI curricula and programs for a K-12 audience (e.g. Elements of AI [5]). However, training and certifying trainers as well as young people in fundamental Robotics/AI topics, combining face-to-face and online teaching units - as done by EDLRIS - is quite unique.

3. Methodology

The general approach of EDLRIS is based upon following main stages: **1) preparation:** conducting a pre-survey among stakeholders and establishing an advisory board with representatives from industry and education; **2) development:** developing Robotics and AI training modules including a certification system to prove the acquired skills of trainers and trainees; **3) train the trainers:** conducting training courses and certifications for trainers (face-to-face (f2f) and online teaching units); **4) train the trainees:** educating and certifying trainees by certified trainers who act as multipliers;

EDLRIS comprises 4 modules: *Robotics Basic/Advanced* and *AI Basic/Advanced*. All modules have a strong focus on hands-on activities and include practical tasks based on the principles of constructionism [6]. *Basic* modules focus on people without any prior knowledge, aiming at building

awareness, motivating and introducing fundamental concepts in an easily comprehensible manner (scope: 24 hours f2f, 20 hours online). *Advanced* modules primarily focus on people who already have prior knowledge in computer science/mathematics, aiming at enabling a deeper understanding of fundamental concepts (scope: 36 hours f2f, 50 hours online).

Exemplary, the following gives an insight into the **Robotics Advanced** module, which puts the focus on a fundamental understanding of robotic arms and mobile robots [7]. Preparatory online sessions provide the necessary basics in calculus, linear algebra and Python programming. During the subsequent f2f units, participants are given two concrete problems: **1)** mathematical description/modelling of a certain robotic arm and its trajectory; **2)** indoor localization and navigation of a mobile robot; By working on these tasks, participants learn about the kinematical model (direct/inverse kinematics, homogeneous transformation, DOF/DOM, Jacobian) as well as sensor fusion and state estimation (probabilistic model, Bayesian and Kalman filter). Teaching tools are paper+pencil exercises, simulators (Python) and the *TurtleBot 2* robotics platform. The module concludes with the final exam (certification).

A detailed description of all modules can be found at [1] and on the project website (edlris.eu).

4. Implementation and Evaluation

In 2019, 19 Robotics and AI training courses were conducted and evaluated using quantitative and qualitative methods. In sum, 271 people participated, whereas 66% also successfully completed the certification. The majority (76%) of participants were trainers. A survey among participants was administered prior and after each course (Likert scale, open-ended questions). Summing up the results, 92% stated that their expectations towards the training were met and over 90% that the face-to-face (f2f) units were essential for their learning success. On the contrary, only 80% agreed that the online units were sufficiently aligned with the f2f units[1]. Furthermore, participants mentioned that the gaps (in terms of complexity) between the *Basic* and *Advanced* modules are too large, making it hard for young trainees to fully understand the complex, advanced topics. In addition to the survey, quantitative pre- and post-tests at *AI Basic* trainings were conducted using a questionnaire with 10 multiple-

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[1]average percentage over all 4 training modules

choice knowledge questions. Data analysis (paired t-test) showed a statistically significant learning gain ($t(21)=18.086$, $p<.001$). Further data analysis is ongoing and more extensive pre-/post-test evaluations will be conducted during the upcoming training courses.

5. Conclusions and Future work

This paper presented the *European Driving License for Robots and Intelligent Systems (EDLRIS)*, a training and certification system to teach people fundamental concepts of Robotics and AI. The first training courses have been implemented and evaluated in Austria and Hungary in 2019, and, due to the great demand, further trainings and certifications will be conducted in 2020. In order to get a better founded assertion regarding the success of the entire system, a more extensive quantitative evaluation will be implemented. Furthermore, contents and structure of the training modules will be adapted according to insights and lessons-learned from the first implementations.

Acknowledgements

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