INTRODUCTION TO CoE AND EEE COURSE

PROJECT DESCRIPTION – Fall 2022

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GOAL

The project aims to combine topics of electrical-electronics engineering (EEE) and computer engineering (CoE) for the design of an autonomous car that can identify simple signs on a given track and then make a decision to speed up, speed down, or to stop. While moving, the autonomous car is expected to move according to the mathematical models that you will develop. The autonomous car is expected to stay in its track without crossing to the next lane.

PROJECT COMPONENTS:

The project involves hardware and software design components of EEE and CoE. The students are expected to have a functional hardware, or the autonomous car that will be provided to students, and then target the hardware with the codes that they will develop. The hardware will be provided by the TA and only one hardware per group will be provided. The students are expected to follow both parts of the course: Hardware + Software which contains the mathematical model implementation, decision making and Artificial Intelligence parts. The course has 5-6 labs that will prepare the students for the hardware development and software integration. For the software part the tools to recognize signs through machine learning and AI approaches will be covered. These will be at the basic level, though those who are more interested in these topics can go beyond the basics.

Students who do not have access to the hardware platform, are expected to use a simulation environment for their project. The recommended simulation platform is LGSVL Simulator. Even with the simulator, the students are expected to implement their mathematical models and AI components.

PROJECT EVALUATION:

A group of typically four/five students will form a team. The group is expected to work on the project from Week 3 of the classes. The groups will have three reports: The proposal report, mid-report, and the final report. For those who will be attending the course online, a channel on MS Teams will be created so that students can form their team. Typically, some students show no interest in the class after the 7th week, hence after the midterm, a reshuffle of the teams can be arranged. Try not to do the project alone.

During the final exams week, you will be asked to make a presentation and a demo of your project. Students with hardware platform will test their car in the track available in our lab in Building C, 2nd floor. Those who prefer to use the simulation, they will present how they develop their project in the simulation platform, implement their mathematical model, and integrate the AI components. Each member of the group need to clearly specify how they contributed to the project and need to present their parts.

Your overall evaluation will be based on your reports, presentation skills, the implementation of mathematical models, integration of AI components, and the overall quality of the demo.

PROJECT CONTENT:

The groups will demonstrate their autonomous car in a given track, which will be prepared by the course TA. A sample track is shown below. We plan to use four signs for the track as shown in Figure 1. The first three signs indicate the speed of the car as cm/sec. When the car sees the speed limit, it has to gradually set its speed to the given limit between 2-3 seconds. For each speed limit, the autonomous car should lid its LEDs: For 5, only one LED, for 10 two LEDs, and for 20 3 LEDs should be lit. This will demonstrate that the object detection is performed correctly. The LEDs should be lit when the speed limits are identified. If the autonomous car sees the Stop Sign, it should the LEDs OFF and stop permanently. Here, for the detection of the signs and speed limits, you are expected to use mathematical models and AI approaches. For AI you can use OpenCV library.
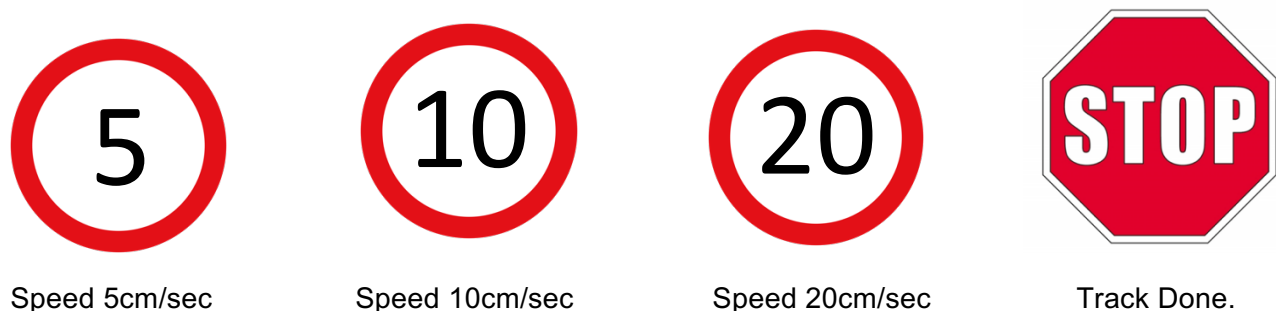

| Speed 5cm/sec | Speed 10cm/sec | Speed 20cm/sec | Track Done. |

Figure 1: Traffic signs to be used on the track.

The autonomous car should be in front of the track and will start within 10 seconds. It then should complete the track without passing over the lines drawn on both sides of the road. The autonomous car will be expected to complete the track in a specified time period. The start lane will be decided by the TA, either left or right. The width of the track will be 50 cm and the sign will have a diameter of 20 cm. The signs will be on both sides of the track for simplicity, 5 cm away from the track lines. The lines on the track will be coloured with white colour, while the

road colour will be in black. We will have dashed orange lines in the middle of the track.

A sample track will be prepared by the TA and will be made available for testing by the 9th week of the classes. A sample track is shown in the following figure. However, your final demo track will be different and will not be shared with you till the demo day. This is to avoid any pre-programming for the track.

Please note that we can make slight changes on the track. However, you will be notified of any changes and this project description document will be updated accordingly.
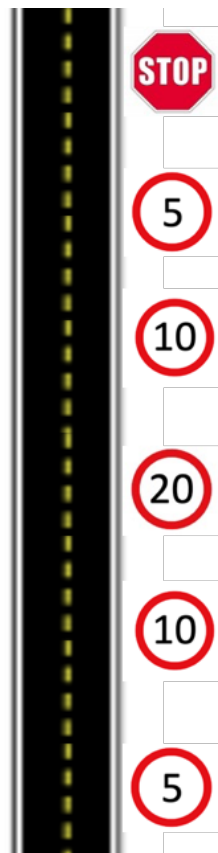

Figure 2: A sample track with dummy signs.