Project Directive

Shamisa Shoja 2023-08-24

Project name	***Autonomous truck***
Client	Shamisa Shoja, ISY
Project leader	Student
Project decision	Shamisa Shoja, ISY
Project time	Reading period 1-2, HT 2023. The project finished at the latest at the project conference.
Reporting	Ongoing reporting: Every week time must be reported per person and activity and a status report submitted. LIPS documents: • Requirements specification • Project plan • Outline timetable • Test plan • Design specification • Test protocol • Time must be reported per person and activity once a week • User manual • Documentation of project results in the form of a technical report • Post-study with follow-up of results and time used Reporting requirements in addition to the LIPS documents: • Oral presentation of final result • Poster presentation • Website describing the project • Film to publish on YouTube
Parties	Customer/Examiner: Daniel Axehill, Automatic Control/ ISY/ LiU Client: Shamisa Shoja, Automatic Control/ ISY /LiU Supervisor: Luca Claude Gino Lebon, Automatic control/ ISY/ LiU Project group: About 6-8 students
The project's background and purpose	The development of advanced driver support systems and algorithms for controlling autonomous vehicles are hot areas in both research and the automotive industry. Being able to safely and smoothly maneuver a vehicle with a trailer in an environment with many obstacles is an example of a task that places great demands on the driver's skill. The truck driver 's work can therefore be made easier by developing driver support systems for the task. In order to carry out research in this area, the automatic control department has built a small-scale Lego truck with

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	trailer, which is equipped with a Raspberry Pi and a Lego EV3 unit.  During previous years' CDIO project, an autonomous system was developed that can maneuver the truck in an environment with static obstacles. To enable rapid development of prototypes, a large part of the development has taken place in a developed simulation environment. After initial tests, ISY's research arena Visionen has since been used for real experiments with the physical Lego truck. The entire system has been developed in the Robot Operating System (ROS) which allows rapid development with both C++ and Python.
The project's goals and effect	The goal of this year's project is to continue the work with the Lego truck and implement the developed system to handle an environment with complex moving obstacles, such as pedestrians and other vehicles. There is generally a lot of uncertainty in how these obstacles move, which makes it extra important to be able to take this uncertainty into account during planning. The tasks will include the following items: • Investigation of models for the prediction of pedestrians and other dynamic obstacles. • Implementation of the existing planning system of the Lego truck (that can handle uncertain moving obstacles in simulation environment) in Visionen. • Development of the system's architecture to enable integration of the new system functions and simplify future development. • Development of the truck's visualization system that uses Visionen 's projector to visualize the environment around the truck as well as its current plan.
The project's long-term goals	The project's long-term goal is to create a robust system that can be used to demonstrate the department's research in autonomous vehicles as well as for teaching advanced control courses at the university. Examples of research that may be carried out on the system in the future are active safety systems and development of algorithms for cooperation between several vehicles in traffic.
Partial deliveries	BP2 must occur no later than three weeks after the first lecture. Then the following must be delivered:

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	• requirement specification • presentation of the system • project plan, including time plan • simple draft of design specification. At BP3, the following must be delivered: • design specification • test plan. At BP4, the following must be delivered: • all sub-modules must be individually tested in simulation or in Stora Visionen. At BP5, the following must be delivered: • all functionality, including test protocols • user guide • presentation where it is shown that the requirements in the requirements specification are met. At BP6 (before the project conference), the following must be delivered: • technical report • follow-up study with follow-up of results and time used • poster presentation • website and film describing the project In addition, time reporting per activity and person as well as status reporting must be submitted to the client once a week. The status report must also be sent to the customer.
Project participant	Project roles that must be present in the project: • Project manager • Document manager • Test manager • Design manager • Software manager The group's collective prior knowledge should preferably include: • C++ and Python programming • ROS • Control theory (reglerteknik) • Signal processing and sensor fusion

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Contacts		**ISY/LiU:** Luca Claude Gino Lebon, luca.claude.gino.lebon@liu.se, (supervisor) Shamisa Shoja, shamisa.shoja@liu.se, (client) Daniel Axehill, daniel.axehill@liu.se, 013-28 40 42 (customer/examiner)
Implementation decision		Taken by customer at BP2.
Purchasing responsibility		All necessary equipment and software are provided by ISY.
Costs		**Project members:** • Each project member must spend 240 hours on the project. **ISY:** • Tutorial time: 40 hours. • Part in room with possibility to connect a computer.
Financing/ Cost center		ISY, Linköping University

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