Master Thesis: Highly Scalable Software Architecture for Intelligent Transportation Systems

Background

Within the PROVIDENTIA project, a section of the highway A9 between Munich and Nuremberg was converted to a testing site for autonomous driving. As part of this, a large sensor network system has been set up along the highway to allow monitoring and steering of traffic as well as to improve the coordination between autonomous and traditional cars. The primary task of the intelligent system is to create a digital traffic twin that accurately represents the physical road situation in real-time. Based on this digital twin, the smart infrastructure can provide a far-reaching and comprehensive view to the drivers and autonomous cars in order to improve their situational awareness within the current traffic environment. A video about the PROVIDENTIA project is available on https://youtu.be/4oCnQlGFuc4.

Description

A complex software system stands and falls with a good software architecture. That is the why, design and implementation of a highly scalable software architecture for safety-critical applications is a central task in the PROVIDENTIA++ project. The tough requirements, the use cases of the application and other value-added services must also be taken into account. Due to the complexity and application-oriented challenges of this system, many interesting research topics are available within this project. These include, but are not limited to:

- **Research various software architectures for intelligent infrastructures**
- **Research on increasing scalability:** How to increase scalability in the purpose of theoretically nationwide rollout in Germany? What are the advantages and disadvantages of a centralized or a decentralized architecture? How could a “plug and play”-mechanism be implemented for the full range of different sensor types? What could an interface to future value-added services look like? How could a run-time adapted architecture look like?
- **Research on increasing safety:** How to increase safety in general? How are safety-critical requirements achieved in other industries (e.g. automotive, aerospace)? How can we increase safety by using data from the Internet 2.0 (Social Networks, Google Maps, …)? How can we measure automatically a key performance indicator for safety for a current traffic situation?
- **Research on increasing reliability:** How can we reach a stable 24/7 system? How can we design with specific elements a failure tolerant architecture? How can we measure automatically a key performance indicator for reliability for a current traffic situation?
- **Your ideas:** Your ideas on this topic are expressly welcome. If a key question is not listed here, you are welcome to suggest it.

Your Tasks

- Familiarization with software architecture via literature research
- Development of a solution approach (e.g. as a prototype) for the specific problem
- Evaluation of the concept using real-life data

Requirements

- A strong interest in autonomous driving, software architectures and programming
- High motivation and ability to work independently
- Good knowledge in at least one programming language: C++, Python

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