Lehrstuhl für Fahrzeugtechnik
Fakultät für Maschinenwesen
Technische Universität München

Interdisciplinary Project

Integration WebRTC for Video Streaming in Teleoperation Software Stack

Situation:

As the fallback soluation of autonomous driving, teleoperation provides the bridging technology for level 4 autonomous driving [1], which enables the operator to control the vehicle remotely. However, teleoperation comes with its own challenges due to the dynamic network condition caused by high mobility of the teleoperated vehicle. Recent advancements in predictive quality of service (QoS) [2] provided the possibility to mitigate this problem by predicting the network condition in advance, which allows the teleoperation software to adapt to the future QoS. One of the measurement is adaptive bitrate (ABR) [3], which adapts the bitrate of the video stream according to the network congestion.

As a powerful tool, google developed Web Real-Time Communication (WebRTC) [4] for real-time communication applications, such as video conferencing, online video streaming, etc. As the state-of-the-art, WebRTC is integrated with Google Congestion Control algorithms [5], which monitors the network congestion and gives an estimation of the bandwidth. Based on this, WebRTC then changes the bitrate and the resolution of the transmitted video automatically.

Project:

Therefore, this project aims to the integrate WebRTC into an existing teleoperation software stack at the Institute of Automotive Technology. To get the full benefits and control of the WebRTC software, the WebRTC Native API (C++) is used for the implementation.

The project can be described by the following tasks:

- Implement a peer connection with a signaling server, a WebRTC client using the WebRTC Native API (C++)
- Implement a bridge for video between the implemented WebRTC client and ROS
- Integrate into the existing teleoperation software

Lecture Recommendations:

- Autonomous Driving Software Engineering (Modul MW2472, available online)

Prerequisites:

- Interest in autonomous and teleoperated driving
- Proficient in C++ and its build tools (cmake/make, ninja)
- Knowledge in network technology
- (Optional) Knowledge for real-time video streaming

Reference:

[1] SAE Levels of Driving Automation - https://www.sae.org/blog/sae-j3016-update

[2] Boban, et al. (2021) - Predictive Quality of Service: The Next Frontier for Fully Autonomous Systems

[3] Bentaleb, et al. (2019) - A Survey on Bitrate Adaptation Schemes for Streaming Media Over HTTP

[4] WebRTC - https://webrtc.org

[5] Carlucci, et al. (2016) - Analysis and design of the google congestion control for web real-time communication (WebRTC)

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