

Field Data Evaluation and Prototype Implementation for Real-Time Video Quality Assessment in Remote Driving

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Abstract

This paper proposes a method for real-time video quality assessment (VQA) during transmission, targeting remote driving or remote monitoring for autonomous driving. The proposed method extends Fast-VQA [1] from offline, file-based evaluation to a sequential update scheme suitable for real-time streaming in remote driving. In addition, we demonstrate the effectiveness of the proposed method with data from an actual driving experiment and present a prototype implementation.

As remote and autonomous driving become widespread [2], video quality is critical for safe operation. Since sudden degradation can delay recognition of pedestrians and vehicles, real-time VQA is important for safe remote driving operations and adaptive video encoding or communication control [3]. However, conventional VQA methods such as SSIM or VMAF require reference videos and are therefore unsuitable for remote driving, where no-reference assessment is essential. Fast-VQA addresses this by estimating perceptual quality without any reference input, making it applicable to real-time transmission.

Fig. 1 (a) illustrates the vehicle video transmission system, where camera video is transmitted via cellular networks to a monitoring server, and Fig. 1 (b) shows the proposed method's block diagram. The method builds upon Fast-VQA, which simulates human subjective assessment by sampling 32 frames from four segments and aggregating the estimated quality into one metric. For real-time operation, 128 frames at 30 fps are evaluated using a sliding window updated every 32 frames, enabling continuous estimation.

Next, we evaluated the proposed method by offline processing of video data collected during actual driving experiments and visualizing the scores. We used GStreamer [4] and cellular communication for video transmission. Fig. 2 (left) shows the temporal changes in VQA scores, with representative high- and low-score frames. Fig. 2 (right) shows the score distribution, where drops under poor communication or complex scenes matched visual degradation. This result demonstrates the method's feasibility in promptly detecting quality degradation without references.

In addition, we developed a prototype real-time VQA system on a PC equipped with a GPU. The system implements a pipeline for receiving, decoding, VQA, and GUI visualization. Through experimental evaluation, we verified that the system can process 720p/30 fps video in real time.

We have implemented and verified a real-time prototype, and are now extending evaluations to live in-vehicle video to further validate performance and optimize the pre-trained Fast-VQA model for remote driving. In this way, we aim to establish a practical real-time quality monitoring technology that contributes to enhancing the safety of remote driving.

Keywords

Video Quality Assessment, Remote Driving, Fast-VQA

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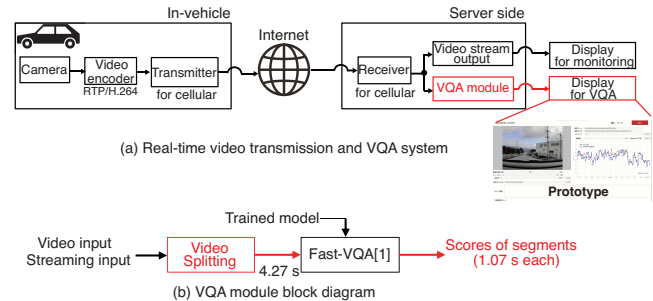


Figure 1: Real-time video transmission and VQA system

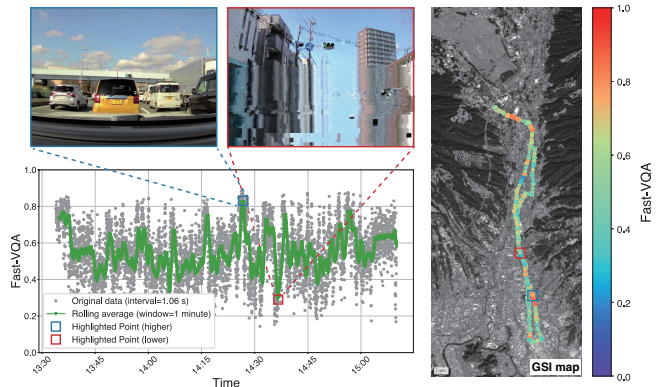


Figure 2: Fast-VQA score distribution along the driving route



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