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ALT: Towards Automating Driver License Testing using Smartphones

Problem:

- Road safety is a major public health issue, with road accidents causing an estimated 1.25 million fatalities and many more injuries each year. The reasons for inadequate or improper testing of drivers are many.
- It is tedious for a human inspector to thoroughly monitor and evaluate all aspects of a license applicant's driving. Indeed, it is quite challenging for an inspector, who is seated beside the driver, to turn and monitor the driver's gaze.

Solution:

- ALT, a low-cost smartphone-based system towards the goal of automating the driver's license test. The windshield-mounted smartphone acts as the sole sensing and computation platform in ALT, and monitors both the driver's gaze and maneuvers to assess the driver's performance.
- A hybrid visual SLAM technique that combines visual features and a sparse set of planar markers, placed optimally in the environment, to derive accurate trajectory information.

Experimental Results:

- ALT has an F1 score of 91% for identifying left/right mirror scans at frame and instance levels, respectively.
- ALT identifies these left/right mirror scan instances with a precision of 85% and recall of 82% (F1 score: 83%).

Pros:

- A robust detection of driver's gaze by combining head pose and eye gaze information, and performing auto-calibration to accommodate environmental variation.
- An efficient realization on smartphones using both CPU and GPU resources. The perform extensive experiments, both in controlled settings and on an actual driving test track, to validate the efficacy of ALT.

Cons:

- Generalization to other tracks: Based on extensive conversations with experts in license testing, It is believed that the core components of ALT would be applicable to driver testing and tracks in general.
- On-the-road testing: While the portable, smartphone-based design of ALT lends itself to going beyond confined tracks and testing on actual roads, our current trajectory estimation still relies on having a sparse set of markers in the environment.

Doubt:

- Using inertial sensor data can increase the accuracy of visual SLAM techniques, but this is done by relying on high sampling rate of inertial sensor data, which is typically not supported by low-end smartphones. How to deal with it?