Research Report Summary

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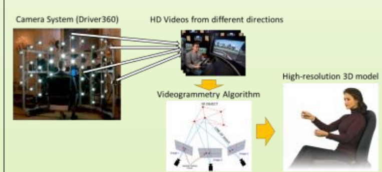
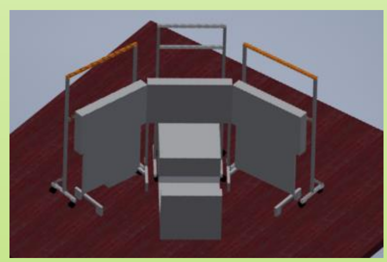
Driver360

A Four-dimensional Scanning System to Better Understand Drivers

In this project, we developed a novel four-dimensional imaging system to capture various driver states and behaviors during simulation. The key idea is to install 32 high-definition cameras around the NADS MiniSim driving simulator and record time-synchronized videos from the 32 different angles. The videos can then be utilized for three main purposes: (a) to acquire a high-quality, driver-specific 3D avatar; (b) to collect anthropometric parameters while driving; and (c) to build a collection of images for training computer vision algorithms.



Overview of the System



CAD modeling of Driver360

Controlled by an electronic trigger system, the Driver360 system permits time-synchronized digital video recording of a driver from 32 angles. Video frames at each time instance are then processed using a technique called photogrammetry, which combines multi-view videos to reconstruct a high-resolution 3D surface model. By repeating this process across time instances, a 4D scan (3D + time) of a driver is obtained.

> *"The Driver360 system permits time-synchronized digital video recording of a driver from 32 angles."*

The new system will serve as a starting point for many innovative driving research studies. The capability of acquiring high-resolution videos enables immediate new research opportunities for measuring and analyzing driving behaviors. Data collected using the system will produce a unique, rich dataset for better understanding drivers. Furthermore, images of drivers collected via the developed system could also be used for accelerated data collection for training computer-vision-based driver state detection and monitoring algorithms. An ability to acquire 3D images of drivers allows the generation of artificial driver images in various scenarios. That is, the 3D reconstructed image of a driver could be rendered under different background and illumination conditions, so a lot of driving scenes could be simulated automatically, without the cost of actual data collection. In this way, numerous driving data could be collected to train computer vision algorithms to be able to detect body motions, gestures, and emotional states, resolving the bottleneck of the current machine-learning-based driver state monitoring approaches. Lastly, the system could also be used for generating a library of realistic driver avatars for simulation. Hence, these will be the future directions of our research.

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