Application Note

Gaze Tracking in Driving Behavior Research

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Introduction

A main reason for traffic accidents is incorrect or belated visual information retrieval. It would therefore be insightful to know more about the driver's acquisition of information.
Thus the following questions shall be formulated and examined in this abstract:

- Are there basic strategies in car drivers' information retrieval?
- Are these strategies susceptible to external interferences, for example by advertising?

Method

The driver's gaze position has been measured in driving trials performed under predefined conditions.

- Ten subjects had to pass a determined test track in an industrial park. A group of actors interacted with the drivers on determined locations of the track. Thus a high reproducibility and comparability could be ensured for all subjects. Driving in a simulator has not been considered as the artificial experimental environment could have falsified the results.
- The driver's gaze was recorded with the iView X HED system. Cameras mounted on a lightweight head unit captured the subject's eye and field of view. After the calibration procedure, the scene video was overlaid with a gaze cursor and saved to an MPEG video file.

Situations:

Subjects have to handle three contrived situations, each with a comparable instance without the elements the investigated element.

- Advertising situation: Passing a bicyclist with and without the presence of a billboard. Then for comparison, the billboard is passed once more later on without the bicyclist.
- Bridge situation: Passing a single-lane bridge in presence of an oncoming car having the right of way, a bicyclist and a pedestrian. For comparison, the bridge is crossed later on without supernumeries.
- Oncoming car with roadway markers and, for comparison, without.

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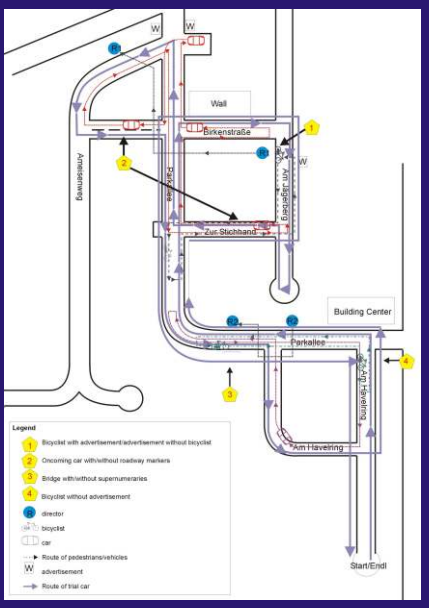
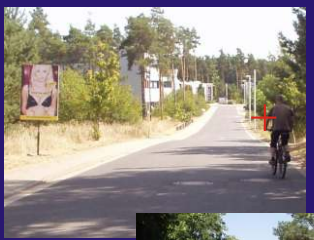
iView X HED System

Operator PC

Calibration procedure

Trial route





Cyclist with billboard

Bridge situation

Oncoming car

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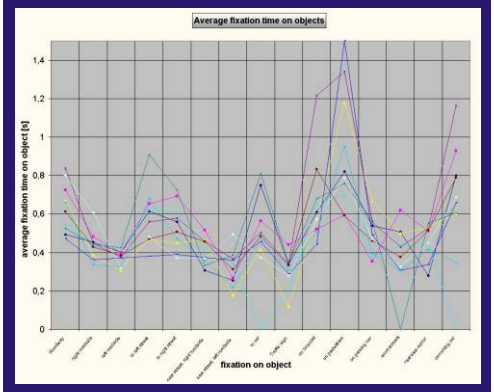

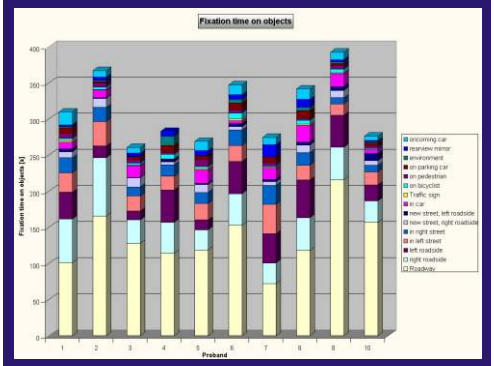

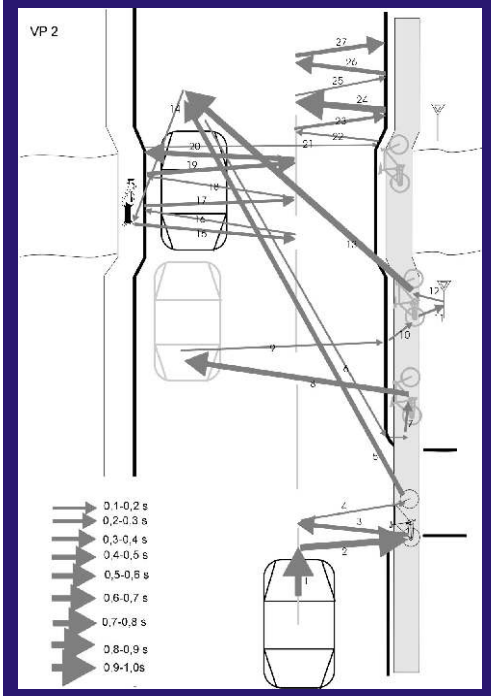

Evaluation

The iView X HED System provides eye tracking videos with an accuracy sufficient for the issues that ought to be investigated (tracking range of 64°, gaze position accuracy of 0.5°).

The gaze videos have been evaluated by dividing the environment into certain regions/objects (e.g. the roadsides or a byciclist) and decoding gazes aiming at them with a software logging keystrokes.

Statistical evaluation

Results

A statistical evalution results in conclusions about the priorities drivers attribute to objects in the traffic environment. Following parameters turned out to be important for the attribution:

- The motion state of the object
- The motion direction of the object
- The distance of the object

criterion	high priority	low priority
motility	movable	immovable
motion state	moving	not moving
motion direction	penetrating own motion vector	not penetrating own motion vector
distance	close	far

More significant conclusions concerning the above-quoted assumptions can be made after evaluating the sequence of the fixated objects (scanpath), e.g.:

Scanpath

- The more complicated a situation gets, the more comparable are the view strategies of the single drivers.
- Detraction risk in environments with a low stimulus concentration is higher than in highly animated environments.
- Experienced drivers position their car by periphere perception and thus have more time left for more important items (rule-based behavior⇢skill-based behavior)

Discussion

The use of an iViewX HED System turned out to be an easy method for revealing the drivers information aquisition, particularly because of the system's easy installation and simple and short calibration process. The results obtained by the iView X HED proved to have a high accuracy and reliability, even for subjects wearing spectacles.

The us of gaze measurement is practical in multifaceted domains, for example in accidental research and reconstruction, or as a valuation tool for current developments in the field of active

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