

# Physiological based automatic driver cognitive distraction detection

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## WHAT is Driver's Cognitive Distraction?



Driver distraction can be categorized into 3 different types: visual distraction, manual distraction and cognitive distraction. Cognitive distraction is happened when a driver's mind is off the road. In psychology this is called as "looked but did not see" or "inattention blindness" phenomena. It has been found that, cognitive distraction is the most dangerous distraction among the three. A closer look at the evidence suggests that the real cause of an accident may lie not in limitations of the driver's low level visual system, but in more cognitive systems involved in attention.

## WHY it is Important and More Dangerous?

Cognitive distraction always lead or shift a driver from putting his attention. A driver can be distracted easily if his focus or attention is not on the road and his surrounding. Since cognitive distraction is an internal distraction, it is totally impossible to be observed directly from an external behaviour. Not like visual and manual distraction, cognitive does not have a direct indicator to indicate when the mind is off the road. Even it is the hardest to be measure, cognitive distraction can be more hazardous than visual and manual distraction. A driver with cognitive distraction can lead him to a delay response, slowly to brake in an urgency events, frequently missed more traffic lights, barely to keep the vehicle on the lane and unable to stay in a safe distance with a leading vehicle.

## HOW To Detect?

Physiological measurement is the best method to use because it is robust and reliable. Movement on features are captured using faceLab Seeing Machine cameras and faceAPI kits. Eye and mouth movements have been chosen as the main features for detection. Eye movement can give a variety of information based on fixation, saccade, movement s (height and width), blinking rate, pupil diameter, gaze rotation and etc. [1][2]. Normally mouth is hardly open when a driver is alert. The maximum width,  $W_{max}$  and maximum height,  $H_{max}$  can indicate different levels of distraction. The height  $H_m$  between top lip and the bottom lip varies greatly when one is talking, yawning or thinking. The mouth movement can be represented in the feature vector as  $Z = (W_{max}, H_{max}, H_m)$  [3].

## WHEN it is Occurred?

It is occurred when the features showed a movement.



There are 24 nodes (hidden and observed) will be detected before a driver is determined as cognitive distracted or not. The decision is based on posterior and prior probability of a network. Features are captured in a real time. Thus, a Dynamic Bayesian Network is the most suitable modelling to be used. F=features, D=distraction.

$$P(F | D) = \frac{\int P(D | p, F) P(p | F) d_p P(F)}{P(D)}$$

|    |                       |    |                 |
|----|-----------------------|----|-----------------|
| 1  | Cognitive distraction | 2  | Visual physical |
| 3  | Face                  | 4  | Eyelid          |
| 5  | Head                  | 6  | Pupil           |
| 7  | Lips                  | 8  | Mouth open      |
| 9  | Eyebrows              | 10 | Eye open        |
| 11 | Track state           | 12 | Gaze quality    |
| 13 | Pupil diameter        | 14 | Gaze rotation   |
| 15 | Pupillary response    | 16 | Inner contour   |
| 17 | Outer contour         | 18 | Mouth width     |
| 19 | Mouth height          | 20 | Left eye        |
| 21 | Right eye             | 22 | Eye width       |
| 23 | Eye height            | 24 | Head rotation   |

