
BODY ELECTRICAL

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39.1 Fatigue Monitoring

1 Warnings and Precautions

1.1 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, the following instructions must be observed.

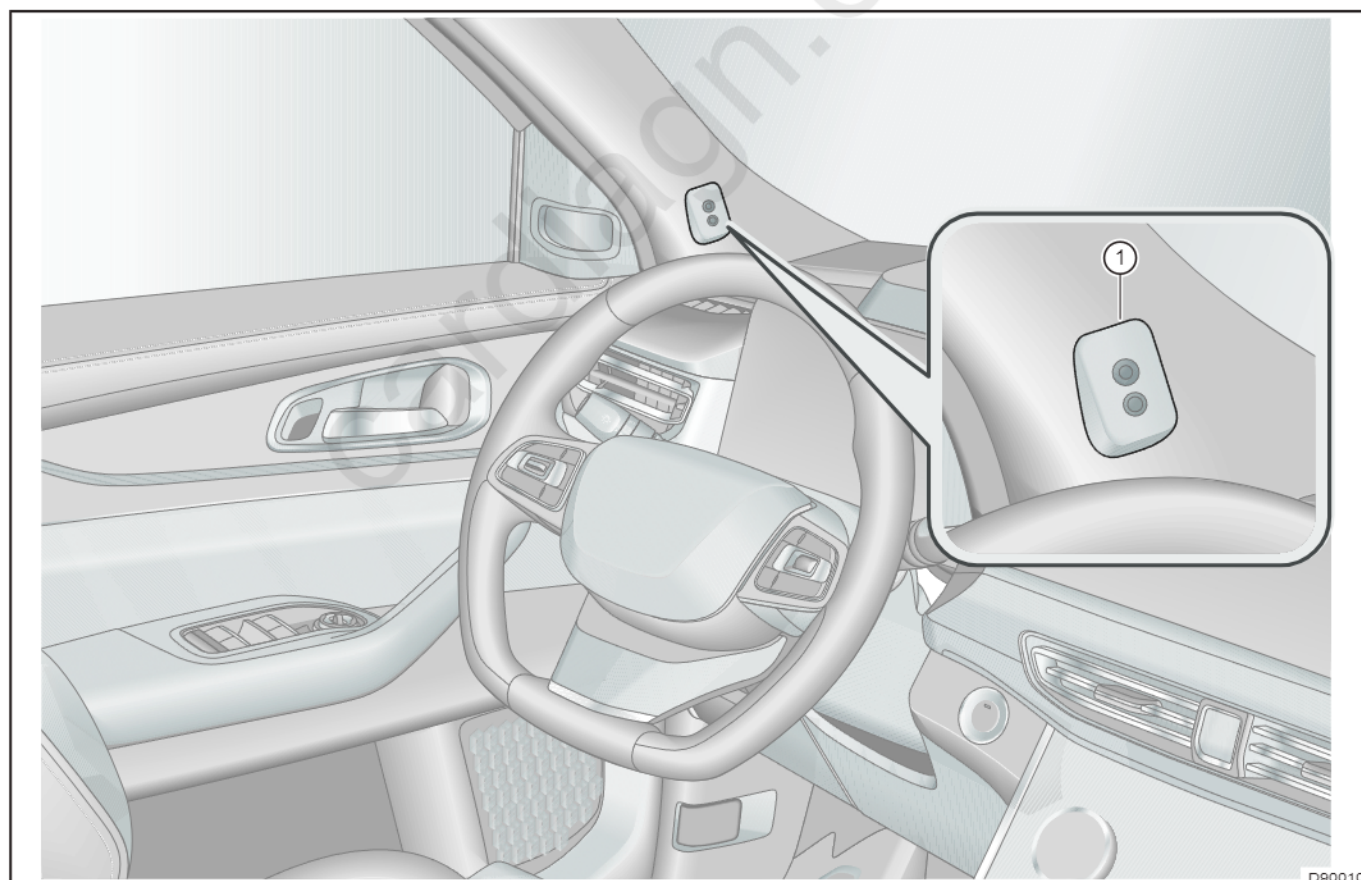
- (1) Be sure to wear necessary safety equipment to prevent accidents, when removing fatigue monitoring camera.
- (2) Appropriate force should be applied when removing fatigue monitoring camera. Be careful not to operate roughly.
- (3) Try to prevent interior and body paint surface from being scratched when removing fatigue monitoring camera.

2 System Overview

2.1 System Description

The fatigue monitoring system monitors driver's physiological image response through the camera, and relies on Baidu Vision AI capabilities. When driver's fatigue and dangerous driving state are found, it uses a series of reminders to keep driver's attention in driving state. Avoid danger caused by fatigue driving.

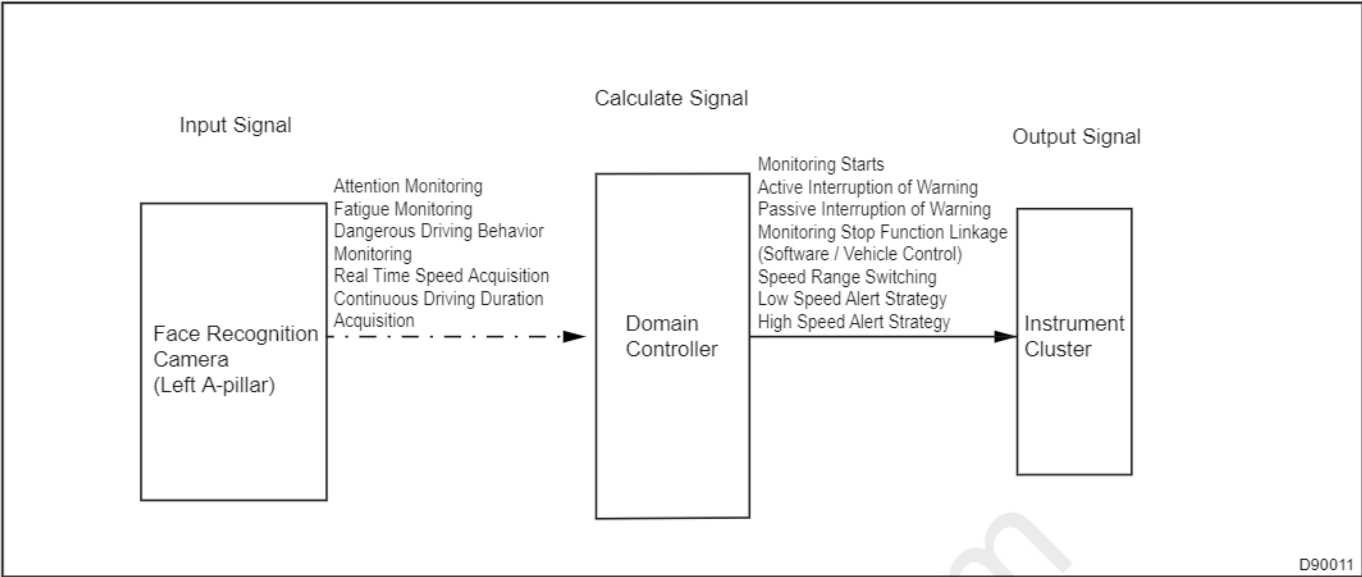
2.2 System Component Diagram



1

Face Recognition Camera

2.3 System Schematic Diagram



For fatigue monitoring, the signal is input by the face recognition camera, calculated by the domain controller and output to the instrument cluster.

2.4 System Function

■ Image recognition

The image data is collected by the camera, and the data is subject to user's natural action. The camera obtains the following contents in the instrument cluster, and the following is an example of the content (- supports recognition of wearing sunglasses, and the camera has an infrared mode to support night recognition):

Category	Action	Diagram	Note
Dangerous driving behavior	Head movement	 D90020	Detect normal head movement, only head movement may be more dangerous. For example, look to the left, look to the right, etc.
	Drink	 T20030	Take water cup and mineral water to drink normally, excluding detection of eating
	Normal smoking	 D90040	

Category	Action	Diagram	Note
	Normal calling	 D90050	What we detect is driver normal calling action. We will give a prompt only when the calling action lasts for a certain period of time
Fatigue driving feature	Normal yawning	 D90060	
	Eyes closed for a long time	 D90070	Head-down drowsiness is detected by the deviation of sight. Since it is impossible to distinguish head-down drowsiness and looking down, data shows that closing eyes for 1.5s-3s is prone to accidents

■ Fatigue monitoring dimension input

Vehicle monitors the following contents and inputs reminder strategy:

Category	Item	Description
Vehicle speed	$0 \text{ km/h} \leq \text{vehicle speed} < 60 \text{ km/h}$	Generally in special road section, congested road section and urban road section.
	$60 \text{ km/h} \leq \text{vehicle speed} < 120 \text{ km/h}$	Generally in urban express lanes, loops and highway, vehicle speed is relatively high, short-term loss of attention may lead to danger.
	Vehicle speed $> 120 \text{ km/h}$	Beyond the speed of domestic road design, facing greater danger.
Frequency and duration of fatigue behavior	Eyes closed	Duration
	Head movement	Duration
	Calling	Times (only prompt after a single call lasts for a certain period of time)
	Yawning	Number of times
	Drinking	Number of times
	Smoking	Number of times

■ Monitoring switch

The monitoring switch automatically controls the start, pause, and end of monitoring, and at the same time performs mode switching according to the real-time speed.

Status	Value
Start monitoring	When vehicle speed reaches 30 km/h, continuous monitoring starts. The speed can exclude temporary parking rest state and some non dangerous states. After detection starts, instrument panel cluster displays DMS icon
Small eye detection	After driving fatigue monitoring system starts, driver is judged to have small eyes if driver closes eyes continuously for 10 s when the face is detected, long-term eye-close warning will be turned off during this trip (In the application of project, it is necessary to strictly control camera point not to be too high, so as to avoid false recognition of closing eyes at viewing angle); When driving behavior monitoring system is on, whether driver has small eyes or not will be judged again every 30 minutes. If driver has small eyes, long-term eye-close warning will be turned off during this trip
Interrupt warning	When user feels excessively disturbed by reminder, user can actively interrupt reminder of Xiaoyun: Wake up Xiaodu (wake up Xiaoyun to interrupt and end the warning state). The above strategy only interrupts this warning
Stop Monitoring	When speed is lower than 30 km/h, detection will be stopped, and detection record will not be cleared. When speed is 0, detection data will be cleared. There is a monitoring switch in setting
Speed range switching (around 30 km/h)	After switching speed range, monitoring duration and times will not be cleared; Switching speed range will not interrupt current reminder.

■ Warning type

According to strategy, warning can be divided into four levels:

Level	Degree	Strategy	Application	Description	Reminder method
Level 1	Weak	User actively perceives	User attention is normal	Mild behaviors are less dangerous and do not need to disturb user excessively.	Icon (triggered separately, see specific behavior).
Level 2	Light	User passively perceives	Users are not focused	User behavior may bring some dangers, so passive perception intervention.	Icon, sound (-triggered separately, see specific behavior).
Level 3	Light	User passively perceives	Users are not focused	User behavior may bring some dangers, so passive	Icon, sound (-uniform design) voice broadcast (triggered separately, see

Level	Degree	Strategy	Application	Description	Reminder method
				perception intervention.	specific behavior).
Level 4	Medium	Continuous sound awaken	User loses some attention	Short time passive perception fails to take effect, so continuous sound awaken will be performed.	Icon, voice broadcast, continuous sound prompt (- long sound is turned off continuously) (- triggered separately, see specific behavior).
Awakening strategy		Wake-up mitigation strategy	After waking up user, make further mitigation	Through music, chatting and navigating to service area.	Music, voice, navigating to service area (- prompt according to time dimension).

■ Reminder strategy

DMS prompts are divided into [basic prompt strategy] and [awakening strategy]

- Basic prompt strategy: Whole basic prompt strategy adopts successive degradation scheme, the first trigger is prompt, the next trigger is prompt, and the degree of prompt will be weakened.

Recognized Behavior	Duration/Times	Slow Mode	Fast Mode
Eyes always closed	2 s	Instrument cluster icon + voice + short sound	Instrument cluster icon + voice + short sound
	4 s	Instrument cluster icon + voice + long sound	Instrument cluster icon + voice + long sound
One way continuous	3 s/1 time	Instrument cluster icon + short sound	Instrument cluster icon + short sound
Line of sight deviation	3 s/2 times	Instrument cluster icon + short sound+ voice	Instrument cluster icon + voice + long sound
	3 s/3 times +	Instrument cluster icon + short sound	Instrument cluster icon + short sound
Yawning	1 time	Instrument cluster icon + sound (awakening strategy)	Instrument cluster icon + sound (awakening strategy)
	2 times	Instrument cluster icon + sound (awakening strategy)	Instrument cluster icon + sound (awakening strategy)
	3 times +	Instrument cluster icon + sound (awakening strategy)	Instrument cluster icon + sound (awakening strategy)
Calling with hand	1 time	Instrument cluster icon + short sound+ voice	Instrument cluster icon + short sound+ voice
	2 times +	Instrument cluster icon	Instrument cluster icon + short sound

Recognized Behavior	Duration/Times	Slow Mode	Fast Mode
Drinking	1 time	Instrument cluster icon + short sound+ voice	Instrument cluster icon + short sound+ voice
	2 times +	Instrument cluster icon	Instrument cluster icon
Smoking	1 time	Instrument cluster icon	Instrument cluster icon
	2 times	Instrument cluster icon + short sound+ voice	Instrument cluster icon + short sound+ voice
	3 times +	Instrument cluster icon	Instrument cluster icon

- The closed eyes state ends (waking up). During the warning process, when the user corresponding fatigue state disappears, the warning ends:

Strategy	Warning Ends
Eyes closed	Closed eyes state ends: Eyes open, images cannot be recognized, camera malfunctions

- Awakening strategy** Awakening strategy scene: For fatigue states such as yawning and long-time eyes closed, “awakening strategy” will be performed after strategy prompt is completed or user wakes up. After the prompt is interrupted by voice interaction, etc., no awakening strategy will be performed this time. Long sound playing strategy (only long eyes closed and line of sight deviation): After playing for 6 s, system actively stops long sound warning.

■ Dangerous driving behavior warning

Line of sight deviation

Logic	Warning Tips
First time in 10 minutes	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s) Sound prompt: Sound (du... du... du...)
Twice in 10 minutes	When speed ≥ 60 km/h, Icon: DMS icon flashes (twice in 1 s, lasts for 2 s); Voice prompt: Don't be distracted, drive well. Xiaoyun finds that you are distracted, pay attention to road conditions ahead and drive well; Continuous sound: Similar to sound effect of unfastened seat belt. When speed < 60 km/h, Icon: DMS icon flashes (twice in 1 s, lasts for 2 s); Short sound prompt: Sound (du... du... du...); Voice prompt: Don't be distracted, drive well. Xiaoyun finds that you are distracted, pay attention to road conditions ahead and drive well.
3 + times in 10 minutes	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s) Sound prompt: Sound (du... du... du...)

Calling

Logic	Warning Tips
First trigger	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s) Sound prompt: Sound (du... du... du...) Voice prompt: Please put down your mobile phone, it's dangerous to make a phone call while driving; It's very dangerous to call while driving. Please pay attention to driving safety.
2nd + trigger (speed ≤ 60 km/h)	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s)
2nd + trigger (speed > 60 km/h)	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s) Sound prompt: Sound (du... du... du...)

Smoking

Logic	Warning Tips
Take the first puff each time (two smoking actions $\geq$ 10 min, count as once)	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s)
Take the second puff each time (two smoking actions $\geq$ 10 min, count as once)	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s) Sound prompt: Sound (du... du... du...) Voice prompt (- only once in the whole process): Choke to death, don't smoke, it's not safe to smoke while driving; Stop smoking and pay attention to driving safety
Take the third puff each time (two smoking actions $\geq$ 10 min, count as once)	Icon: DMS icon flashes

Drinking

Logic	Warning Tips
Drink water for the first time in the whole process	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s) Sound prompt: Sound (du... du... du...) Voice prompt: Drinking water is dangerous when driving, pay attention next time
Drink water for the second time in the whole process	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s)

■ Warning of mild fatigue**Basic prompt strategy**

Trigger Condition	Warning Tips
Mild fatigue (yawn) for the first time	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s) Sound prompt: Sound (du... du... du...) Voice prompt: Prompt end, execute awakening strategy
Mild fatigue (yawn) for the twice + time	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s) Sound prompt: Sound (du... du... du...) Voice prompt: Prompt end, execute awakening strategy

Awakening strategy

- Trigger time: Trigger after the end of basic prompt.
- Time judgment: From the starting time of last awakening strategy (yawn + eyes closed).
- Judge whether music is playing: Just listen, local, Bluetooth, FM (provided by Neusoft interface).

■ Warning of severe fatigue**Basic prompt strategy**

Trigger Condition	Warning Tips
Severe fatigue: Eyes closed for 2 s for a long time	Icon: DMS icon flashes (twice in 1 s, lasts for 2 s) Sound prompt: Similar to sound of not fastening seat belt. Voice prompt: Wake up quickly, pay attention to road condition, it is very dangerous
Eyes closed for 4 s	As above
State of eyes closed for a long time ends	Trigger awakening strategy

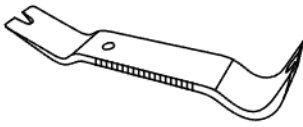
Multiple triggers: Basic prompt strategy of multiple triggers does not make degradation distinction.

Awakening strategy

- Trigger time: Severe fatigue, user wakes up, after the end of basic prompt strategy.
- Judgment of navigating to service area: If it is at a high speed (speed > 60 km/h), navigation guidance strategy will be implemented, otherwise, only voice prompt: Are you very sleepy? Find a place to rest.

39.2 ON-VEHICLE SERVICE

1 Tool

Tool Name	Tool Drawing
Interior Crow Plate	 S00020

2 Removal and Installation of Fatigue Monitoring Camera

2.1 Removal

Warning
• Be sure to wear necessary safety equipment to prevent accidents, when removing fatigue monitoring camera. • Appropriate force should be applied when removing fatigue monitoring camera. Be careful not to operate roughly. • Try to prevent interior and body paint surface from being scratched when removing fatigue monitoring camera.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the left A-pillar upper protector.
- (4) Disconnect the fatigue monitoring camera wire harness connector.
- (5) Remove the fatigue monitoring camera.

2.2 Installation

- (1) Install the fatigue monitoring camera.
- (2) Connect the fatigue monitoring camera wire harness connector.
- (3) Install the left A-pillar upper protector.
- (4) Install the negative battery cable.
- (5) Press ENGINE START STOP switch and perform running test.