ABSTRACT
This paper presents an automatic driving interaction strategy and interface. A majority of recently developed advanced vehicles have been equipped with copilot systems. The copilot system is cooperative driving between a driver and the system. During the automated driving, the system may propose the takeover request to the driver at any time. Thus, it is to be expected that human and systems interaction frequently of the switch control mode and transfer control authority. This study proposed a safety takeover strategy and interface. It is an adaptive adjustment of warning time of driver takeover target when the system request to the driver.

INTRODUCTION
In recent years, all vehicle profit-making businesses are actively developing autopilot vehicle. Many autopilot vehicles has been entered the road-driving test. Autopilot system can effectively improve traffic safety, and provide a safe driving environment, become the future trend of the development of vehicle science and technology. The SAE (Society of Automotive Engineers) in 2014 for the automatic driving system proposed SAE-J3016 grading standards [1]. The SAE-J3016 classifies vehicle automation as Level0 to Level5. A revised version of SAE-J3016, it was released in September 2016. The global automotive industry is also widely accepted to use the SAE-J3016 standard. Many literatures have proposed control strategy common driving state of the autopilot system. M. Saffarian [2] presents the human problem and design method of the autopilot system. This discusses the realization of the autopilot system in cooperative adaptive cruise control of human problems. F. Frank [3] presents a common driving control and control interface approach for automated assist driving systems. In the security conditions of SAE level3 copilot systems that the driver has the highest level at control limits of authority. The driver can take over control at any time when to switch the control mode is safety. Another situation, when requested by the co-pilot system, the driver must immediately respond to the co-pilot's request. Thus, it is to be expected that human and systems interaction frequently for switch and transfer the control mode and control authority. There must be a safe way to complete the transfer of control authority. This paper proposes a model and interface on the automated vehicle platform. The decision-making processes of switching operations between the drive and the automatic drive system clearly defined. The expectation of SAE-Level3 systems is that the driver can be called back to resume control in a little time, we propose a method of adaptive adjustment of warning time of driver takeover target. The system gives a fixed warning time and assesses the different actual takeover time. The system requests the driver take over when adaptability assessment time is feasible. Otherwise, the system enters minimum risk control. Provide the driver with sufficient time to take over the control of the vehicle. Improve the safety of the driving system mode transfer.

SYSTEM STRATEGY AND INTERFACE
Autopilot system can provide a safe driving environment, effectively to improve traffic safety. On the road, Level3 automated vehicles will be a mode of transition where people will be required to retake control of the systems at certain times. The driver manual controls the vehicle through control interface such as throttle, brake, steering wheel, touch screen, and so on. When the system requests, the driver must respond to a control decision, and system through the human-machine interaction interface to inform the driver of the current behavior of the vehicle dynamics. An interactive strategy model applied to drivers and copilot systems as shown in figure1 is a four-mode interface model [4][5].

Between the driver and autopilot system, interaction behavior can simplify as a problem of vehicle control transfer that the system-triggered transitions depicted as solid lines, and the user-triggered transitions depicted by dashed lines. When the driver pressing the button, transitions of control can request or initiated. All user modes and partial state information can display in a gauge cluster based on graphical interfaces. According to transitions of control, the paper proposes the four-mode models of user interaction interface. The four-mode model consists of interface mode, machine and interaction state. The interface mode includes Manual, Override, Active and Required.

The graphical user interfaces for the interface model is implemented on the embedded system of the co-pilot system. In Figure 2, the Left area represented a mode in the ACC, LFS or AEB system, and its colors distinguish the modes, Green indicates active, gray indicates canceled. The figures in the center of the graphical user interfaces represent the internal state of the active mode. The figures in the right of the graphical user interfaces represent the alarm of the active mode.
We propose a method of adaptive adjustment time to the driver to take over the vehicle. Adaptive adjustment warning time strategies, depending on the control ability of the system to the environment, the driver status to provide different takeover functions and response times.

Assuming that the driving state is a sequence $S(N)$, The $N$ driving status collection from the $P$ time to the present, there are $N$ sampling times (1) and (2).

$$S(N) = \{D(N), D(N-1), ..., D(N-P+1)\}$$

(1)

$$D(N) = \{d_f, d_i, d_r, d_h, d_a, d_e\}$$

(2)

The Calculation Formula of Driving Ability Evaluation $\rho(N)$ is equation (3). $\omega_i$ is expressed as weight of different status coefficient.

$$\rho(N) = \sum_{i=P-1}^{N-2} \omega_i \times D(i)$$

(3)

$D(N)$ is the driver state, the autopilot system operating frequency $d_f$, the number of takeover for the driver $d_i$, the time to drive attention to the HMI messages $d_r$, the driver takes over the time $d_h$, the number of times the system has issued an alert $d_a$, number of takeover failures $d_e$.

Finally, Takeover time $T$ given by equation (4) $\alpha$ and $\beta$ is a weight of different values given according to the emergency level of driving event. The takeover time must be greater than the time to collision.

$$T(N) = \alpha \times \rho(N) + \beta, \quad T(N) > TTC$$

(4)

**CONCLUSION**

In this study, we proposed an adaptive adjustment of the warning time of driver takeover target when the system request to the driver. The results got an average take over time of 3.1 seconds can understand takeover time security of the system. This parameter can initial definition of the system takeover time of the final segment warning time. The first segment warning time was an adaptive adjustment. That improves the interactive decision-making system design parameter. Thus, this system has designed a tolerance takeover time of 3 seconds. The driver does not need to receive a warning to take over the vehicle control immediately. Another situation (ex. system failure), the system will transfer the minimum risk mode. The method can greatly enhance the safety of control mode switching.

**REFERENCES**


