TECHNOLOGICAL DEVELOPMENT OF DRIVING SUPPORT SYSTEMS BASED ON HUMAN BEHAVIORAL CHARACTERISTICS

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Driving support and cruise assist systems are of growing importance in achieving both road traffic safety and convenience. Such driver support seeks to achieve, with the highest possible quality, nothing less than "driver-vehicle symbiosis under all conditions." At the same time, many traffic accidents result from improper driver behavior. The author focuses on driver behavior under various driving conditions, conducting detailed measurement and analysis of visual perception and attention characteristics as well as perceptual characteristics involved in driving. The aim in doing so is to support research on driving support systems and driving workload reduction technologies that function as human-vehicle systems and take such characteristics into account.

1. INTRODUCTION

With increasing vehicle computerization, driving support and cruise-assist systems are of growing importance in achieving both road traffic safety and convenience. Such driving and cruise support for drivers seeks to achieve, with the highest possible quality, nothing less than "driver-vehicle symbiosis under all conditions." At the same time, many traffic accidents result from improper driver behavior, that is, errors in the sequence of recognition, judgment and operation.

Driving behavior is the control of a vehicle through a process of driver recognition, judgment and operation based on environmental information input, and functions as a human-vehicle-environment system with constant feedback in the form of information from the outside world and the kinetic state of the vehicle. Accordingly, an understanding of the human characteristics related to the actions involved in driving and the mechanisms by which drivers recognize their surroundings is indispensable to the development of driving support technologies. It is also important to approach the issue in terms of all three elements: humans, vehicles and the environment. Here, we can point out the following issues related to driving support technology aimed at accident reduction, as indicated in Figure 1: 1) driver recognition and judgment characteristics; 2) understanding the relationship between traffic environment and driving psychology; 3) the nature of the interface linking driving behavior and support systems; and 4) solutions for preventing human error. In addition, with regard to issues of recognition and psychology, it is also desirable to be attentive to the latest advances in research on the brain and nervous system, which underlie human characteristics. Discussing driving support technology in terms of human characteristics and proposing ways to reduce traffic accidents are matters of the highest priority.

Meanwhile, with the increasing computerization of vehicles and the advances in intelligent transportation system (ITS) technology in recent years, preventing the data processing errors attendant to adoption of in-vehicle information devices and systems like car navigation systems has grown in importance and interface design that reduces driving load is now indispensable. This has led to research in recognition, perception and behavioral characteristics, including psychological factors involved in decision-making while driving[1-6]. Surveying trends in such research we see a vigorous examination of case studies, including collection and analysis of near-miss incident data and a design approach that takes into account the driving operation characteristics involved in vehicle motion and chassis control[7]. In addition, there has been progress in assessing and verifying the compatibility of advanced driving and cruise support technology with
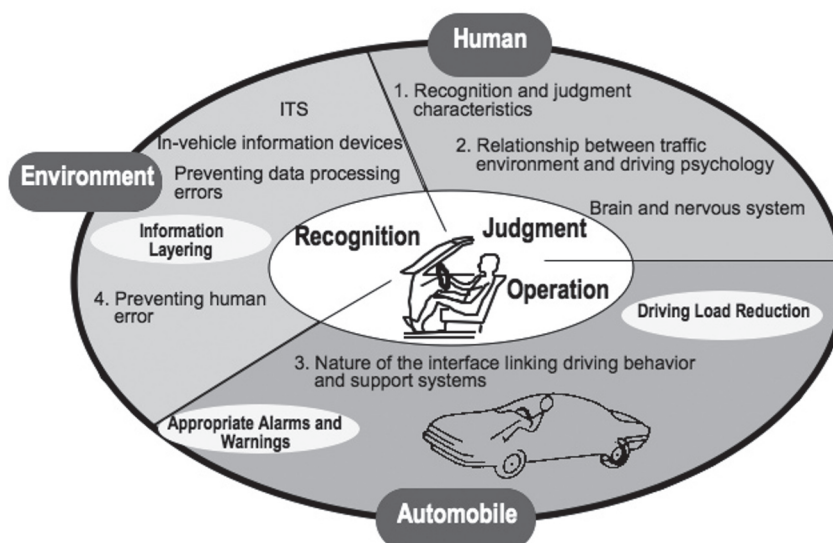
Fig. 1 Strategic domain for driving support system technology

driver characteristics[8,9].

In this paper we focus on driver behavioral characteristics under various driving conditions and consider visual perception and attention characteristics. We also conduct detailed measurement and analysis of the perceptual characteristics involved in driving. Our goal in doing so is to support basic research on driving support systems and driving load reduction technologies that function as human-vehicle systems and take such characteristics into account.

based on the analysis of driving behavior and other human recognition and perceptual characteristics remains important in overcoming the issues that accompany computerization. In addition, trends in user diversification, aging and individualization demand more sophisticated methods for evaluating such characteristics. In other words, an approach rooted in human behavior is required when looking at the human attention allocation and information processing mechanisms that determine the convenience of driving support for drivers.

2. DRIVING SUPPORT DEVICES AND HUMAN-MACHINE INTERFACE (HMI) ISSUES

Looking into technological issues and research trends for the near future based on current technological developments, it first seems likely that IT and ITS will gain momentum and society will become markedly more information-driven. In addition, in a society of ubiquitous networks where information is available anytime and anywhere, there will be a need for safer and more convenient driving environments. Furthermore, automobiles tailored to such societal trends will increasingly be in demand.

Figure 2 organizes driver interface issues related to driving safety support and cruise assist systems by driving condition category (expressways, ordinary roads or urban areas). The diagram envisions misinformation and system trouble at the point of contact between driver and device and organizes the issues facing systems in preventing such problems. As can be seen, an approach

3. DRIVING BEHAVIOR CHARACTERISTICS

3.1 Driving processes and support system approaches

Driving behavior can be conceived, as mentioned above, as a chain of consecutive behaviors, with individual behaviors and their causes seen in light of traveling conditions and driver psychological state. Drivers are first aware (recognize and perceive) their situation, then engage in decision-making and response selection, and finally execute individual operations. Both driving conditions, that is, information from the outside world, and vehicle conditions change from moment to moment. Depending on which process within this chain of behaviors one looks at, one can envision different corresponding driving support systems. Seen in this way, as described in Figure 3, depending on how one analyzes driving behaviors, there is a three-stage approach for systems supporting various driving processes: 1) measurement of