ICT for ITS and Automated Driving: Honda's Effort

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1. Introduction

Over the last few years, a growing number of driver assistance systems using on-board sensors have been brought into practical use. Research and development of automated driving technology for practical applications have also been gaining momentum worldwide at organizations including Google. Although this research is currently focused on autonomous systems using on-board sensors, the use of V2X systems based on wireless communication technology will hold the vital key for future functional advances. This article introduces Honda's efforts related to these technologies.

2. Honda's environmental and safety vision

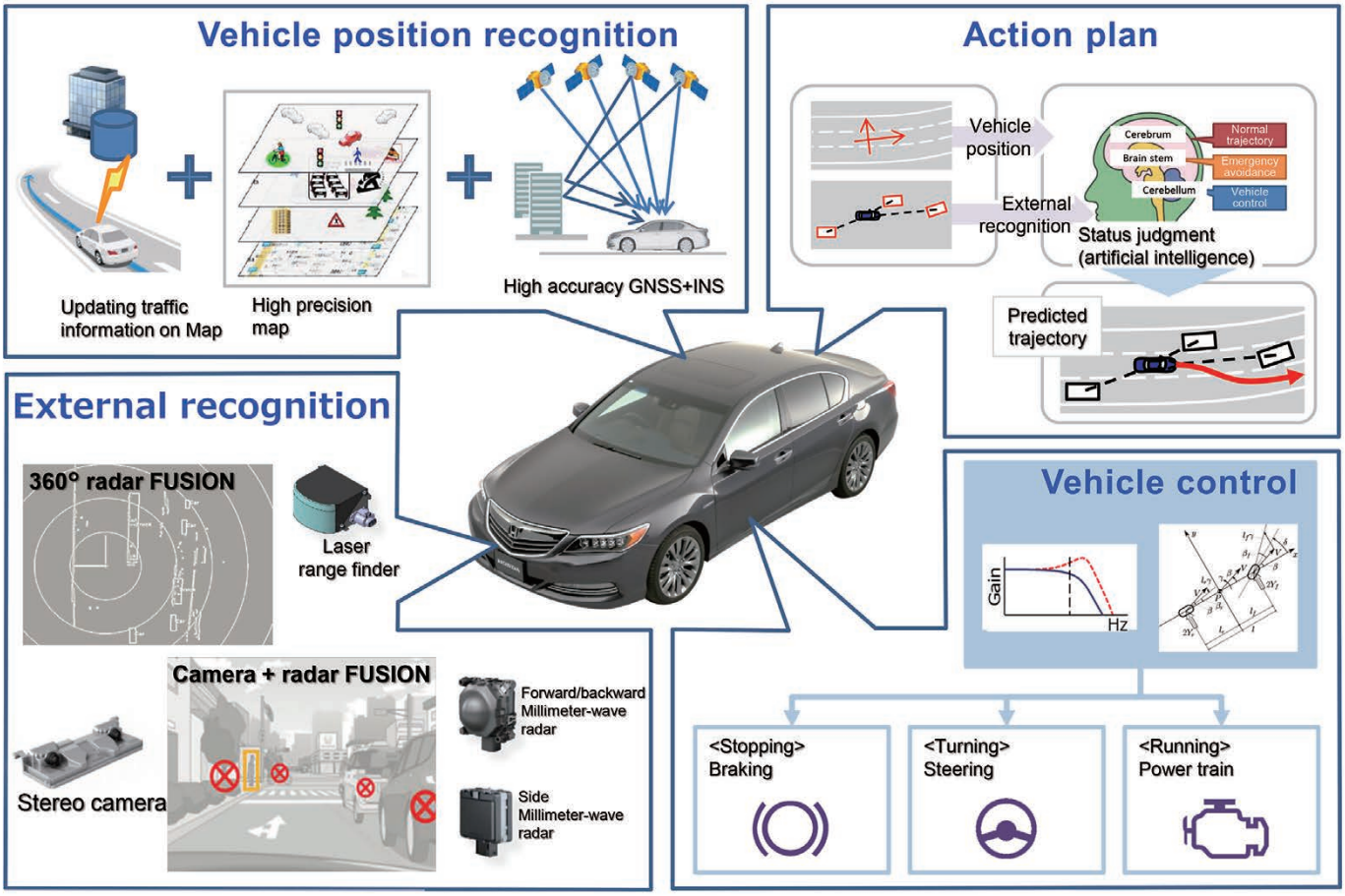
Honda's goal is to realize "the Joy and Freedom of Mobility" and "a Sustainable Society where People Can Enjoy Life". We consider that driver assistance systems and automated driving systems are essential to realize "the Joy and Freedom of Mobility" in safe, secure, and comfortable manner. We are conducting active research and development with the aim of developing practical applications as soon as possible.

3. Expectations of ITS and automated driving technology

Various research organizations have reported analysis results showing that over 90% of traffic accidents are caused by driver error. In Japan, 52.7% of traffic fatalities in 2013 were people aged 65 and over. A survey report by the Cabinet Office revealed that the economic loss of traffic accidents was ¥6.3 trillion in 2009.

Figure 1: Honda SENSING

Figure 2: Automated driving system configuration example



According to the information economy innovation strategy of the Ministry of Economy, Trade and Industry, 3.2 billion hours are lost every year in traffic congestion, which equates to economic losses of ¥9 trillion. It is hoped that these statistics can be improved by working towards an accident-free society, enhancing the flow of traffic to relieve congestion and improve punctuality, and reducing the energy consumed by transportation.

4. Current status of driving support technology

Last year, Honda announced a new advanced driver assistance system called "Honda SENSING." This system supports driving not only in the forward direction but also in reverse and sideways. Honda SENSING enables the detection of pedestrians in addition to conventional collision avoidance braking. Other new technologies have also been added, including Pedestrian Collision Mitigation Steering System, Road Departure Mitigation (RDM) system, Adaptive Cruise Control (ACC) with Low-Speed Follow, and Traffic Sign Recognition. The driving environment recognition technology used to implement each of the forward safety systems is configured by a sensor fusion technology incorporating a 77 GHz electronic scanning millimeter-wave radar and a monocular color camera. To detect objects in complex situations, the camera recognizes the attributes and size of target objects, and the radar recognizes the position and speed of the target objects while traveling at high speed. Compared with conventional systems, the radar detection range is expanded, the camera resolution is enhanced (equivalent to HD television), and the computation performance of the system is improved. As a result, the system's recognition performance has been improved approximately fourfold compared with a conventional system. These new technologies are being sequentially introduced starting with Honda's new Odyssey and Legend models.

Moreover, with respect to Honda's "Green Wave" driving support system, which makes use of traffic signal information, we are working on large-scale demonstration and testing of the system by Honda employees on public roads in Utsunomiya city, Tochigi prefecture, and we are monitoring its effects on changes in safety-related vehicle behavior, improvement of fuel consumption, traffic flow and so on. (Figure 1)

5. Current state of automated driving technology

With regard to technical development, auto manufacturers are working independently in some areas such as vehicle position recognition, road environment recognition, action planning and vehicle control, while in other areas they are cooperating to tackle issues together. Vehicle position recognition technology

Figure 3: Honda's work on automated driving support

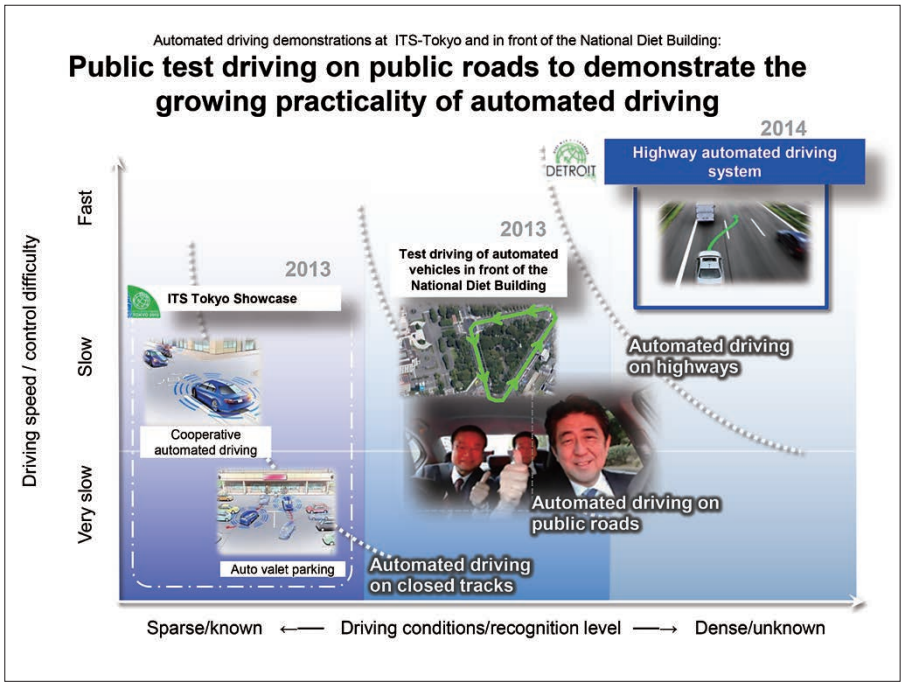
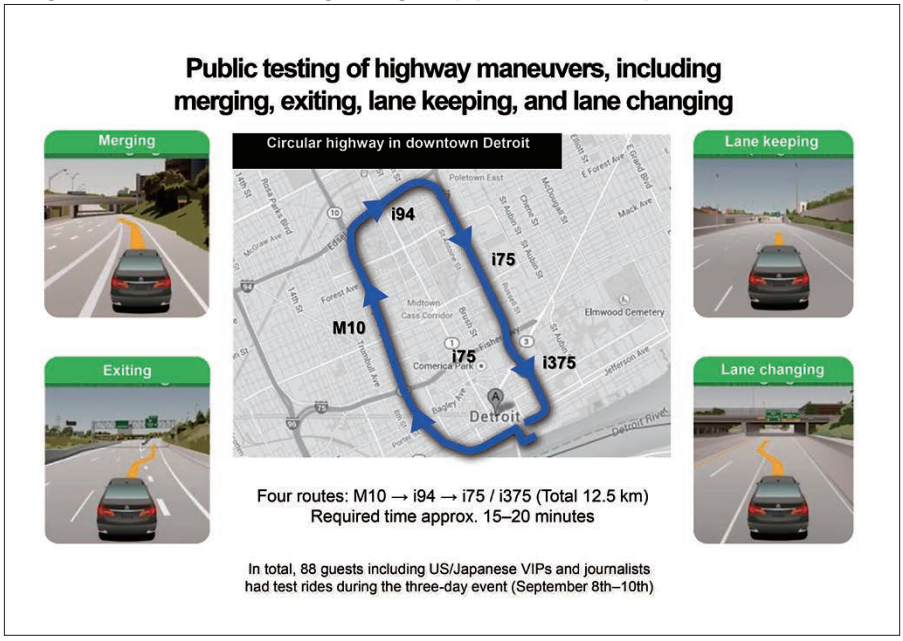


Figure 4: Automated driving on highway (Demonstration)



(localization) for car navigation systems has been already put to practical use. However, automated driving requires recognition technology that is more accurate and combines macro-scale vehicle position recognition (to recognize the vehicle's current position on the predicted route between the starting point and destination) with micro-scale vehicle position recognition so that the vehicle can recognize multiple lanes and choose the correct one for going straight or turning left or right at intersections, and so on. External recognition technology must be able to identify objects up to a required distance over a 360° range around the vehicle by using a complex combination of sensors based on various different detection principles that have already been put to practical use in the Advanced Driver Assistance System. An automated driving action plan is produced based on the results of these vehicle position recognition external recognition. This action plan (e.g., trajectories for normal driving and emergency avoidance) is formulated based on comprehensive perception and judgment of the position, orientation and speed of one's own vehicle and other vehicles, and other road environment conditions (such as the presence of obstacles). (Figure 2)

Honda's activities related to automated driving technology include demonstrations of automatic valet parking and cooperative automated driving in a restricted area at ITS Tokyo in 2013. In November of the same year, we carried out test drives with VIPs on an ordinary road in front of the National Diet Building. As the Honda showcase at ITS Detroit in 2014, we gave a demonstration of automated driving including automatic merging, branching, and lane change on a highway near Cobo Hall, in which 88 people were involved. (Figure 3,4)

6. Summary

When implementing automated driving systems, there are a diverse range of technical and other issues that need to be addressed. To overcome these issues, it is possible to consider vehicle position recognition, external recognition, action planning, vehicle control and the like as competitive areas of each company. On the other hand, although a dynamic map infrastructure needs to be developed to solve these issues, there is a limit to what can be achieved by individual companies working independently. So there is also a need for cooperative efforts involving not only the automotive industry, but also the communications industry and relevant government agencies. Similarly, it may become necessary to cooperate in order to prepare facilities for verification testing of functions such as V2X and HMI.

As legal and social initiatives for the realization of automated driving vehicles, it is important to achieve consistency with current international road agreements, and in particular to clarify assignment of roles and division of responsibilities between the driver and the system. To encourage the spread of this technology, it will also be necessary to promote international standardization efforts in partnership with Europe and the United States, to engage with social campaigns, and to verify the acceptability of this technology to other road users in a mixed driving environment.